3.5 Civil/Structural Design

The civil/structural design of ES-CO/R/S includes the site location, mobilization of equipment in preparation for operations, grading and drainage, roads and walkways, demobilization, utilities, excavation, temporary containment tents, and equipment skids.

3.5.1 Site Location

The project work area is located northeast of TAN-607. This site is in the area between Bear Blvd and the west side of TAN-607. TAN-616 currently is located within this area and is in the process of being demolished. The finish grade at this location is currently gravel and dirt.

3.5.2 Site Development

3.5.2.1 Mobilization

Mobilization work will be performed in preparation for field operations. This work consists of the implementation of required administrative, engineering, and health and safety controls. Mobilization work will include, but is not limited to: delivery and storage of material and equipment, set up of field operation site offices, identification and demarcation of work areas including temporary barriers and signage.

3.5.2.2 Grading & Drainage

The work area will be leveled and graded and approximately 4 inches of crushed gravel will be added and compacted to provide a level, all-weather working surface. The total project area will include areas for process equipment, material storage, container storage, vehicle, and personnel access. Dust control during grading will be minimized in accordance with IDAPA standards.

3.5.2.3 Onsite drainage control

Onsite drainage control is designed to control contaminated water within the contaminated area and restrict contaminated water from running offsite. An earthen containment berm constructed around the perimeter of the contaminated area will restrict offsite flows and prevent additional runoff from entering the site. Storm water will be allowed to collect in multiple areas onsite to limit the amount of water that will have to be managed. Any onsite runoff that collects in any area within the site that does not infiltrate into the ground within 24 hours of the storm event, will be pumped and stored onsite for subsequent treatment as required.

Secondary containment will be provided for the process area by constructing a separate containment berm within the work area. This area will be lined with a 20 mil. PVC liner with a 16 oz. geotextile cushion layer. The 1 ft. high berm will provide a total containment volume of 61,000 gal. and will enclose all stages of the treatment until the oxidized waste has been grouted.

3.5.2.4 Offsite drainage control

Offsite drainage control is designed to restrict offsite storm water from running onto the contaminated site. Restricting the amount of storm water run-on minimizes the amount of contaminated water that must be treated or managed. Protective controls include re-routing of roof drains and downspouts on all buildings adjacent to the site to direct the storm water outside of the controlled contaminated area. Perimeter control ditches will direct storm water around the containment area. Existing ditches will be re-routed around the area to prevent contamination without interrupting the remaining site drainage system.

3.5.2.5 Roads, Walkways, etc.

There is an existing paved road (Bear Blvd) which provides access to the west side of the proposed site. Personnel office trailers will be located along this road, outside of the containment area. Ramps will be provided for vehicle access into the containment berm for equipment and material deliveries. A 4-ft high perimeter fence will be constructed around the containment area to control access. Gates will be provided for vehicles and personnel.

3.5.2.6 Demobilization

Upon completion of the remedial action activities, and all equipment has been decontaminated, personnel will demobilize and remove all equipment and materials from the work site. The containment berm and graveled work area will be left in place to support the tank removal phase of the project.

3.5.3 Utilities

Existing utilities will not be disturbed during this project. The project will use the TAN water supply.

3.5.4 Excavation

Minimal excavation work will be required. The sumps of each of the TSF-09 tanks (V-1, V-2, and V-3) will be accessed to remove the final contents of the tanks.

The sump of each tank will be accessed by the following method. A vacuum excavation system will be used to drill a 24-inch diameter hole through the soil to the top of each tank. High-pressure air will be directed through an air lance nozzle to breakup soil, and a vacuum tube is used to retrieve the soil into a 55-gallon drums. The system will prevent damage to underground piping and will not require shoring.

A 12-inch pipe casing will be installed in the excavated shaft and will extend from just above ground to the surface to the top of the tank. The annulus around the pipe will be filled with concrete. The joint between the tank and casing will be sealed by filling the inside of the pipe with approximately 3 inches of a polyurethane sealant and filling the excavated shaft around the pipe with lean concrete.

Portable drilling equipment will then be brought in and set up over the pipe casing. A core drill will be used to drill though the polyurethane sealant and the tank wall. The drill pipe will be disconnected from the rig, welded into place, and a flange installed to cap the pipe. This process is shown in drawing C-4 of Appendix C.

3.5.5 Temporary Containment Tents

Temporary containment tents will be provided over the process equipment and vessels. These tents will be provided for protection from the weather. Tents will be constructed of PVC fabric and tubular steel framing and will be equipped with removable panels for ventilation and windows for visibility and lighting.

3.5.6 Equipment Skids

Process equipment will be provided on steel framed portable skids or trailers. Skids will be of sufficient height to elevate equipment above the finish grade. Equipment such as the ribbon mixer may require a substantial skid and platform.

3.6 Electrical Design

This section describes the conceptual design of the electrical systems used for ES-CO/R/S. These include:

- Power
- Lighting
- Instrumentation
- Life safety.

These systems, along with the electrical quality requirements, are detailed below.

3.6.1 Power

A diesel generator sized to accommodate the expected electrical usage plus 25% will provide the electrical power. Generator selection will account for 24 hours per day usage on a seven-day workweek. 480VAC 3ϕ, 240VAC 3ϕ and 110VAC 1ϕ power will be provided. The diesel power generator will be leased/rented unit as a complete package, including distribution panels and secondary fuel containment.

Two 120VAC outlets on each of the four skids will be reserved for non-dedicated use. These non-dedicated outlets will be distributed between the various equipment skids.

A Multiqup 320 KW diesel generator unit was selected for conceptual design. Physical characteristic are shown in Table 12 and available power is listed in Table 13.

Table 12. Physical Characteristics of the Diesel Generator.

Height	83"
Width	56"
Length	166"
Weight	11,950 lbs
Sound Level	69 dB @ 23 ft.
Fuel Tank Capacity	129.5 gal
Fuel Consumption	20.4 gph @ full load
	15.8 gph @ ¾ load
	11.0gph @ ½ load
	6.6 gph @ ¼ load

Table 13. Diesel Generator Electrical Output.

Volts	Amps
Single Phase 120V	888.9 A (4 wire)
Single Phase 240V	444.4 A (4wire)
Three Phase 240V	962 A
Three Phase 480V	481 A

The fuel consumption of the Multiqup 320 KW diesel generator unit detailed in Table 12 will require refueling every 6.4 to 20 hours of diesel operation depending on the applied load.

An emergency-stop master relay(s) will control the main system power. Activation of any E-Stop button will kill all power to the process and stop all motors. A secondary 120VAC circuit uncontrolled by the emergency stop relay will be available for lighting and the instrument and computer power. This non-E-stop controlled power will allow the computer system to continue to monitor all instruments and process variables even in an emergency shutdown situation.

3.6.1.1 Backup Power

A second generator shall be available to provide backup power should the main generator fail. Backup power will be less than the main generator and will provide only the power necessary for safety and to provide for a controlled process shutdown. There will be no automatic transfer of power between the two generators. A manual switch will be used to transfer to backup power.

3.6.1.2 Equipment Loads

Table 14 shows the system power loads. The power listed is a conservative estimate based on the knowledge available at conceptual design.

All monitors will require a fused disconnect and either a motor starter or a variable speed drive. Refer to drawing E-1 (Appendix C) for typical motor wiring schematics.

Table 14. System power loads

System	Power		Basis
	480 Volt	120 Volt	
MFJPMS	14.4kW (30 A)		TRA MFJPMS Requirement
RV1 Pump	1.12kW (1.5Hp)		Spx25
RV2 Pump	1.12kW (1.5Hp)		Spx25
RV In Pump	3.73kW (5Hp)		Spx40
Condenser Pump	1.12kW (1.5Hp)		Spx25
RV Heater/Chiller	250kW		Mechanical Engr. Estimate
Off Gas Heater	15kW		P&ID
Condenser Pump-1		.746 KW (1Hp)	
Condenser Pump-2		.746 KW (1Hp)	
Off Gas Blower-1	1.5kW (2Hp)		
Off Gas Blower-2	1.5kW (2Hp)		
Condenser Heater-chiller	5kW		
Lighting	18.75kW		
General use non-dedicated plugs		7.2 KW	4 - 15 amp circuits
Control Trailer Power		7.2KW	

3.6.2 Lighting

All areas where work is performed, including exits and entrances, must be adequately lit. Regulation (29 CFR 1926.56 a) requires 5 to 10 Foot-Candles of light for general construction areas and in mechanical and electrical working areas. This requirement would apply to V-Tank operations that take place under a tent or are carried out during the evening and night hours.

Portable light stands with 1000 to 2000 watts will be placed in and around the work areas to provide lighting meeting CFR regulations. For metal Halide lighting, 0.32 watts per square foot would be required to meet the requirements. Lighting poles should be spaced not more than 4 times the mounting height of their luminaries apart from one another. Specific task lighting may also be required where precision is important. Light stands should be weather proof and have NEMA 4X enclosures for high voltage ballast components.

Branch lighting circuits feeding temporary lighting should be kept entirely separate from power circuits, except for a common supply. Branch circuits should be protected by a breaker or fuse.

Listed below are some of the hazards that temporary lighting can present. The following good practices should be incorporated into the design.

- Avoid contact with wires strung for temporary lighting.
- Avoid tripping hazards with wires strung for lighting.
- Place light stands away from traffic areas.
- Do not use temporary lighting circuits as extension cords.
- Use floodlight approach wherever possible to provide maximum visibility of structures.
- Locate and aim floodlights away from workers' normal viewing directions and toward areas to be watched.

Lighting design will include quartz re-strike lighting to meet warm up and cool down requirements of metal halide lights.

3.6.3 Instrumentation

Instrumentation is required as shown on the P&ID drawings (Appendix C). Redundancy of instrumentation has been provided on the reaction vessels for Ph, level, Cl, and temperature to allow for continuous operations. Instrumentation sensors will require protection from the corrosive state of the process fluids. All local readouts and instrument transmitters must be weather proof and sealed from the environment and tied into a data logger.

All instruments will require calibration after system assembly and after on site installation. This test will provide the basis for offset, hysteresis, and accuracy baselines for data collection and systems operation. Typical instrument loop diagrams are shown in drawing IN-1 (Appendix C).

- **Temperature**

Thermocouples will be used for temperature measurement. Thermocouples will be placed in thermo-wells to protect them from the corrosive process environment. Standard type K thermocouples are adequate for the temperature ranges required.

- **Pressure**

Pressure gage instrumentation (the difference between measured and atmospheric pressures) will be required. Each pressure gage will require a two-valve manifold for maintenance and calibration. There are no special requirements for the pressure measurement gages.

- **Differential Pressure**

Differential pressure measurements will be required. Each pressure gage will require a five-valve manifold for maintenance and calibration.

- **pH Measurement**

pH measurements via pH electrodes will be require on each reaction vessel and on the condenser in the off-gas system. Placement of electrodes to guarantee contact with the waste stream will be critical.

- **Foam Level Detection**

Detection of the foam level in the reaction vessels will be required. Foam level detection will be accomplished using intrusive conductive level sensors placed at various levels in the side of the vessel. If preoperational testing shows poor conductivity of the foam, then intrusive optical (nonconductive) sensors will be used as direct replacement sensors for the conductive sensors.

- **Chlorine**

Chlorine measurements will be made in the reaction vessels and at the off-gas condenser. Measurements will be accomplished using Ion Chromatograph insertion probes.

- **Gas Chromatograph/Mass Spectrophotometer**

A small gas chromatograph/mass spectrophotometer will be required at the project location to analyze samples taken from the reaction vessel. Samples will be analyzed for VOCs.

- **Flow Sensors**

Flow measurement is required on all pumps, waste streams and reagent piping. Flow measurements will be required for dry bulk solids, powers, pellets, fluids and gas streams. Each system will have unique attributes such as product size, density, fluidity, flow rate and corrosiveness. Off the shelf flow devices are available that will meet the projects requirements.

- **Off-gas Monitoring**

The off gas released from the stack will be monitored for radioactive contaminants using a constant air monitor. CO_2 and Mg hand held sniffers/samplers will be available for monitoring the off-gas stream.

3.6.4 Life Safety

Radiological monitoring will be required and placed as directed by TAN Radiological Control. Fire safety will be directed by TAN safety.

3.6.5 Quality Requirements

All electrical components, instrumentation sensors, and PLC control equipment will be consumer grade. Any software (purchased or developed) will comply with MCP-550 Software Management.

3.7 Regulatory Compliance

The V-Tanks are being managed as one remediation project (OU 1-10 Group 2 sites). The waste in these tanks is also being managed as one waste stream. The overall concentration of hazardous constituents in the tanks will be used to characterize the waste and to determine the appropriate treatment standards that must be met prior to the waste being disposed.

This section details the treatment codes and standards that apply to V-Tank waste remediation.

3.7.1 Waste Characterization

Waste in the V-Tanks has been characterized as an F001 waste because of the usage of trichloroethylene and other solvents for their solvent properties. Analytical data and process knowledge indicate that the contents on the V-Tanks do not exhibit the characteristics of hazardous waste (i.e. D-codes) with possible exceptions for certain organic chemicals where the analytical detection limit was above the regulatory characteristic limit. Further sampling may eliminate the application of the "D" code to this waste stream. Until that sampling data is available, however, the waste stream is also considered characteristic for the chemicals listed in Table 15.

Table 15. V-Tank applicable D-codes.

Code	Characteristic Chemical
D028	1,2-Dichloroethane
D029	1,1-Dichloroethylene
D030	2,4-Dinitrotoluene
D032	Hexachlorobenzene
D033	Hexachlorobutadiene
D034	Hexachloroethane
D042	2,4,6-Trichlorophenol
D043	Vinyl Chloride

3.7.2 Applicable Treatment Standards

Each of the treatment standards cited in the tables below contain treatment standards for non-waste waters. The waste in the V-Tanks is a non-wastewater because it contains greater than 1% total suspended solids and/or greater than 1% total organic carbon. If some of the water is drawn off and treated separately, that water could be subject to the waste water treatment standards. A summary of the non-wastewater standards is shown in Table 16.

Table 16. F001 Applicable non-wastewater treatment standards.

F001 Listed Chemicals	CAS Number	Non W/W (mg/L)
Acetone	67-64-1	160
Benzene	71-43-2	10
n-Buthyl alcohol	71-36-3	2.6
Carbon disulfide	75-15-0	NA
Carbon tetrachloride	56-23-5	6.0
Chlorobenzene	108-90-7	6.0
o-Cresol	95-48-7	5.6
m-Cresol (difficult to distinguish from p-cresol)	108-39-4	5.6
p-Cresol (difficult to distinguish from m-cresol)	106-44-5	5.6
Cresol-mixed isomers (Cresylic acid) (sum of o-, m-, and p-cresol concentrations)	1319-77-3	11.2
Cyclohexanone	108-94-1	NA
o-Dichlorobenzene	95-50-1	6.0
Ethyl acetate	141-78-6	33
Ethyl benzene	100-41-4	10
Ethyl ether	60-29-7	160
Isobutyl alcohol	78-83-1	170
Methanol	67-56-1	NA
Methylene chloride	75-9-2	30
Methyl ethyl ketone	78-93-3	36
Methyl isobutyl ketone	108-10-1	33
Nitrobenzene	98-95-3	14
Pyridine	110-86-1	16
Tetrachloroethylene	127-18-4	6.0
Toluene	108-88-3	10
1,1,1-Trichloroethane	71-55-6	6.0
1,1,2-Trichloroethane	79-00-5	6.0
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	30
Trichloroethylene	79-01-6	6.0
Trichlorofluoromethane	75-69-4	30
Xylenes-mixed isomers (sum of o-, m-, and p-xylene concentrations)	1330-20-7	30

Due to the assumption of characteristically hazardous V-Tank wastes, the "D" code treatment standards associated with non-wastewaters will also have to be met. These standards are shown in Table 17.

Table 17. "D" Codes and required treatment standards.

Code	Characteristic Chemical	Treatment Standard
		Non W/W (mg/kg)
D028	1,2-Dichloroethane	6
D029	1,1-Dichloroethylene	6
D030	2,4-Dinitrotoluene	140
D032	Hexachlorobenzene	10
D033	Hexachlorobutadiene	5.6
D034	Hexachloroethane	30
D042	2,4,6-Trichlorophenol	7.4
D043	Vinyl Chloride	6

The presumed presence of "D" coded waste also triggers the requirement for meeting the Universal Treatment Standards (UTS) for the 253 Underlying Hazardous Constituents (UHC) listed in 40 CFR 268.48. This requires the waste stream to be evaluated for the likely presence of UHCs that may be present. The generator is not required to test for all 253 UHCs, but must assess their likelihood of being present. Of these 253 constituents, 26 are included in the F001 list, 8 are covered by the assigned "D" codes, 5 are excluded from being considered as UHCs, 11 do not have non-wastewater treatment standards, and 117 are not reasonably expected to be present. Analytical data is available for 37 of these UHCs that show that the constituent is not present at levels above the treatment standard. The existing data shows two organics and two metals above UTS levels. These UHCs will have to meet treatment standards if any of the "D" codes remain applicable. In addition, there are 31 other organic UHCs where the detection level was higher than the UTS. These six UHCs as well as 13 other UHCs that were not analyzed will require an assessment of the likelihood of their presence. Any of these that are determined to be likely to be present, will require possible treatment and analysis to demonstrate compliance with UTS. The appropriate non-wastewater treatment standards for the UHCs confirmed to be present above the UTS levels are in Table 18.

Table 18. Underlying Hazardous Constituents and Universal Treatment Standards.

Underlying Hazardous Constituent	Universal Treatment Standard
PCBs	10 mg/kg
bis-2-ethylhexylpthalate	28 mg/kg
Cadmium	0.19 mg/L TCLP
Mercury	0.025 mg/L TCLP

Any of the supernate from V-3 that is drawn off and placed in the AGTST that is not used for flushing of the tanks and is not eventually run through the chemical oxidation/reduction processes will be required to meet the LDR wastewater treatment standards. Passing this wastewater through the granular activated carbon bed is expected to be sufficient to meet these standards. Based on the presently available data the following treatment standards would apply. The wastewater treatment standards for the F001 code are in Table 19; the standards for the "D" codes are in Table 20, and the UTS in Table 21.

Table 19. F001 standards for V-3 Supernate if not processed in chemical oxidation system.

Constituent	Wastewater Treatment Standard (mg/L)
Acetone	0.28
Benzene	0.14
n-Buthyl alcohol	5.6
Carbon disulfide	3.8
Carbon tetrachloride	0.057
Chlorobenzene	0.057
o-Cresol	0.11
m-Cresol (difficult to distinguish from p-cresol)	0.77
p-Cresol (difficult to distinguish from m-cresol)	0.77
Cresol-mixed isomers (Cresylic acid) (sum of o-, m-, and p-cresol concentrations)	0.88
Cyclohexanone	0.36
o-Dichlorobenzene	0.088
Ethyl acetate	0.34
Ethyl benzene	0.057
Ethyl ether	0.12
Isobutyl alcohol	5.6
Methanol	5.6
Methylene chloride	0.089
Methyl ethyl ketone	0.28
Methyl isobutyl ketone	0.14
Nitrobenzene	0.068
Pyridine	0.014
Tetrachloroethylene	0.056
Toluene	0.080
1,1,1-Trichloroethane	0.054
1,1,2-Trichloroethane	0.054
1,1,2-Trichloro-1,2,2-trifluoroethane	0.057
Trichloroethylene	0.054
Trichlorofluoromethane	0.020
Xylenes-mixed isomers (sum of o-, m-, and p-xylene concentrations)	0.32

Table 20. D-codes for V-3 supernate if not processed in chemical oxidation system.

Constituent	Standard Source	Wastewater Treatment Standard (mg/L)
2,4-Dinitrotoluene	D030	0.32
Hexachlorobenzene	D032	0.055
Hexachlorobutadiene	D033	0.055

Table 21. Treatment Standards for V-3 Supernate if not processed in chemical oxidation system.

Constituent	Wastewaters Treatment Standard (mg/L)
o-Dichlorobenzene	0.088
Nitrobenzene	0.068
Pyridine	0.014
Trichloroethylene	0.054
Total PCBs	0.10
2,4-Dinitrotoluene	0.32
Hexachlorobenzene	0.055
Hexachlorobutadiene	0.055
1,2-Dichloroethylene	0.2

3.7.3 TSCA Treatment Requirements

TSCA regulations regulate the management and disposal of PCB contaminated waste. Because the sludges in the V-Tanks contains over 50 ppm PCBs, the tanks and the water (and the materials that came in contact with them) must be managed in accordance with TSCA regulations as PCB remediation waste under 40 CFR 761.61. A risk based petition will be prepared in accordance with 40 CFR 761.61(c) to allow the V-Tank waste to be treated by chemical oxidation followed by stabilization. This petition will be prepared and submitted in coordination with the ROD Amendment in 2003.

3.7.4 Treated Waste Disposal

All waste removed from the V-Tanks is expected to be shipped to the ICDF for disposal. Waste shipped to the ICDF from waste area groups (WAG) other than WAG 3 at the INEEL must meet the RCRA Land Disposal Restrictions (LDR). Chemical Oxidation treats the waste to meet applicable organic treatment standards, and the stabilization (grouting) of the waste treats the waste sufficiently to meet applicable inorganic treatment standards.

3.7.5 Post Treatment Sampling

Immediately after the waste has been stabilized a sample will be collected from each disposal container. These samples will be collected and protected until the grout has had a chance to cure. A representative number of these samples will be analyzed to confirm that this waste meets the ICDF waste acceptance criteria. ICDF personnel may also collect independent samples for their own uses.

3.7.6 Off-gas monitoring

The off gas will be monitored to confirm that the off gas control train is operating correctly. This will include a VOC monitor, a mercury monitor, and a differential pressure monitor.

3.7.7 Stack Monitoring for Radioactive Particulate Releases

The off gas released from the stack does not require monitoring for radioactive particulate releases (INEEL 2003), however, off gas releases from the stack will be monitored for radioactive particulate using a constant air monitoring system in accordance with applicable ANSI and company standards.

3.7.8 Diesel Generator Emissions

Operating the two diesel generator units, one primary and one backup, does not require additional permit approvals (INEEL, APAD 3-10, 2003) and a Maximum Achievable Control Technology (MACT) permit is not applicable.

3.7.9 Equipment Disposition

All equipment that comes in direct contact with the waste must either be decontaminated for future use or be treated to meet the debris treatment standards for disposal at the ICDF.

3.8 Fire Protection

Portable fire extinguishers will be provided to protect against fire. Portable extinguishers will provide the proper amount of fire protection because the system is a temporary outdoor system involving no flammable liquids or gases.

3.9 Long Lead/Critical Equipment

The following items are considered long/lead critical equipment and the lead times should be considered in future designs and scheduling activities.

3.9.1 Reaction Vessel

The Chemical Oxidation Reaction Vessel is a specialized, glass-lined vessel constructed specifically for the purpose of chemically treating fluids. The RA-48 Series vessel from Pfaudler, Inc. incorporates a paddle mixer/agitator for uniformly mixing the contents of the vessel. It also incorporates a "jacket" to enable heating and/or cooling of the contents in the vessel. All of these capabilities are required for the V-Tank oxidation process.

A 500-gallon working capacity RA-48 Series vessel is required for use in the oxidation process. There will only be a maximum of approximately 200 gallons of waste and additives in the tank during processing. The remaining ~300 gallons is to provide sufficient space to prevent unwanted excursions into the off-gas system due to foaming or boiling conditions.

Because of the 200-gallon batch size, jacket heating and cooling capabilities will be limited to the lower 200-gallon volume of the vessel. This modification plus addition/removal of specified access ports for monitoring devices creates an 18-20 week lead-time.

3.9.2 Mobile Fluidic Pulse Jet Mixing System

The MFJPMS system will be purchased. The mobile fluidic jet pulse mixing system is a specialized system designed for mixing and retrieving contents such as those found in the V-Tanks. Purchase of this system creates a 6 to 9 month lead-time.

3.10 Technical Uncertainties Associated with the Conceptual Design Effort

Because of schedule requirements, the conceptual design for the ES-CO/R/S of the V-Tank waste is being performed in advance of any lab-scale treatability study testing. These treatability studies are currently underway at Mountain States Energy, Inc. in Butte, MT, and should be completed in time to be incorporated into the title design of the chemical oxidation activity. Due to this fact, the conceptual design currently has a number of technical uncertainties. A number of assumptions have been made to address these technical uncertainties. However, the results of the treatability studies may show that the assumptions used to address these uncertainties are not valid.

Technical uncertainties requiring further testing and analysis in future design efforts that have already been detailed in previous sections of this report are:

- Corrosion testing
- Grout formulation
- Lowering the MFPJMS several feet below grade to assist in the suspension of the oxidized waste.

The following items are also considered uncertainties at this stage of design. Each one is discussed in detail below.

- The reaction rate of hydrogen peroxide
- The reaction rate constant for hydrogen peroxide oxidation of VOCs, PCBs, and BEHP
- The reaction rate constant for sodium persulfate oxidation of oils
- The need for sodium persulfate as an oxidant
- The rate of hydrogen peroxide decomposition
- Agitation, suspension, and pumping of the oxidized waste

- Cracking and expansion in the stabilized waste form
- The potential for a "runaway" reaction.

3.10.1 Reaction Rate of Hydrogen Peroxide

It is uncertain whether the actual reaction rate of hydrogen peroxide with hazardous organics can be approximated using a pseudo first-order equation, relating the rate of chemical oxidation to the concentration of chemical oxidant in the waste. A possibility exists that the reaction rate is second order at low concentrations. If the treatability studies find this to be the case, the time associated with chemically oxidizing the hazardous organics to their regulated levels may prove to be impractical. If this is the case, the title design may have different batch sizes, or chemical oxidants (such as only sodium persulfate) that have demonstrated pseudo first-order behavior. The probability of Fenton's reagent not exhibiting pseudo first-order behavior, at low concentrations, and its effect on chemical oxidation behavior, is considered low.

3.10.2 Reaction Rate Constant for Hydrogen Peroxide Oxidation of VOCs, PCBs, and BEHP

The conceptual design assumes that the reaction rate constant for hydrogen peroxide oxidation (under Fenton conditions) of the hazardous VOCs (TCE, TCA, and PCE) is 0.1/min at 40°C, while the reaction rate constant for hydrogen peroxide oxidation (under Fenton conditions) of PCBs and BEHP is 0.1/min at 80°C. The assumption of these reaction rate constants was necessary because of the paucity of data on the chemical oxidation of these contaminants, using Fenton's reagent. Even if such data was readily available, however, an accurate reaction rate constant cannot be confirmed until after actual lab testing data is performed on simulated and actual samples of the V-Tank waste. This is because of the multi-phase nature of the waste. The 0.1/min reaction rate constant for VOCs, at 40°C, was assumed simply because it was similar to the lowest level of reaction rate constants observed for sodium persulfate oxidation of the VOCs, at 80°C. The 0.1/min reaction rate constant for PCBs and BEHP, at 80°C, was simply assumed from ORNL data showing that the reaction rate for ion exchange resins (similar chemical structure to PCBs and BEHP) was between 0.05/min and 0.25/min, at temperatures between 60°C and 80°C. A primary need of the ongoing laboratory-scale tests is to define the reaction rate constants for each regulated organic (TCE, PCE, TCA, PCB, and BEHP) in simulated V-Tank waste, as a function of temperature. Future treatability studies should seek the same type of information, as applied to actual V-Tank wastes. If laboratory studies indicate that the actual reaction rate constants are lower than currently assumed (0.1/min), the time for reaction completion would need to be extended, under current rates of addition. If lab studies indicate that the actual rate constants are higher, there may be a lack of sufficient cooling capacity for the current conceptual design, under proposed rates of addition. However, these factors can be compensated for by raising or lowering the rates of hydrogen peroxide addition to simulate the rates of chemical oxidation. Therefore, the risk of differing reaction rate constants on the proposed design is low to moderate.

3.10.3 Reaction Rate Constant for Sodium Persulfate Oxidation of Oils

The reaction rate constant for sodium persulfate oxidation of oil was assumed at 80°C in this conceptual design. The reaction rate constant of ~0.004/min was determined by taking the calculated reaction rate constant for sodium persulfate oxidation of TNT at 80°C, and multiplying it by a published ratio of kerosene destruction rate vs. TNT destruction rate, for sodium persulfate. In addition, it was assumed that only sodium persulfate was able to oxidize the oil-phase of the V-Tank waste (not Fenton's reagent). An objective of the laboratory studies should be to better define the reaction rate constants for the oil-phase material in the waste for both Fenton's reagent and sodium persulfate, as a function of temperature. If the lab studies indicate substantially different reaction rate constants than currently assumed, the rate of sodium persulfate addition will need to be changed, to effect a rate of oil destruction similar to that proposed for the conceptual design. A possible advantage would be if the data indicates that the rate constant for chemical oxidation of oil is substantially less than that for the regulated organics in the waste. If so, there may not be a need to oxidize the oil-phase of the waste, prior to stabilization.

3.10.4 The Need for Sodium Persulfate as an Oxidant

A review of chemical oxidation indicates that chemical oxidation is preferential to regulated organics, vs. saturated aliphatic compounds, such as the oils and greases that are expected to reside in the V-Tank wastes, in substantial concentrations. If this is the case, there may be a possibility that chemical oxidation will only have to be performed to the extent necessary to destroy the regulated organics in the V-Tank waste. Such a condition would be a significant factor in the proposed chemical oxidation effort, since it may not be necessary to add the large quantities of sodium persulfate that are currently proposed for oxidizing the oil-phase. Even if the lab-scale data shows this to be true, there also needs to be a method to indicate when all of the regulated organics (TCE, PCE, TCA, PCB, and BEHP) have been sufficiently oxidized so the chemical oxidation process may be stopped. A method for evaluating this include at- or on-line GC/MS analysis of the VOCs, and/or on-line IC analysis of inorganic chloride concentration in the waste (since most of the hazardous inorganics are chlorinated, and will produce hydrogen chloride, following their chemical oxidation). It was conservatively assumed that all organics in the waste would have to be oxidized before the oxidation process could be considered complete. However, it is expected that the laboratory studies will indicate that not all of the oil-phase in the waste will need to be oxidized, before chemical oxidation can be considered complete.

3.10.5 The Rate of Hydrogen Peroxide Decomposition

It was also assumed that minimal hydrogen peroxide decomposition occurs during Fenton's reagent oxidation, at both 40°C and 80°C. This assumption is contrary to some data from the Oak Ridge National Laboratory oxidation effort, indicating significant (but not excessive) hydrogen peroxide decomposition at 100°C. Another objective of the current laboratory studies should be to define the rate of hydrogen peroxide decomposition experienced during Fenton's reagent oxidation of the V-Tank simulated and actual wastes, as a function of temperature. The data needs to only evaluate this rate at the proposed conditions (pH of 3-5) that have been pre-identified for the Fenton's reagent reactions. The degree of hydrogen peroxide decomposition experienced at 40°C and 80°C will cause the rate of hydrogen peroxide addition to be increased, such that the rate of hydrogen peroxide destruction solely associated with chemical oxidation of the organics remains the same as currently envisioned in the conceptual design. The hydrogen peroxide decomposition also produces some heat of reaction that should be taken into account. According to calculations performed in support of this conceptual design, the proposed design is sufficiently over-designed for hydrogen peroxide decomposition, provided no more than 43 wt% of the original hydrogen peroxide addition is decomposed during chemical oxidation. If greater than 43 wt% hydrogen peroxide decomposition is experienced, either the time for Fenton's reagent oxidation will need to be increased, or the cooling capacity of the reaction vessels will have to be increased. The probability for such a high rate of hydrogen peroxide decomposition occurring is judged to be moderate.

3.10.6 Agitation, Suspension, and Pumping of the Oxidized Waste

Under the conceptual design, there is a substantial volume of sodium persulfate added to each batch of V-Tank waste, as part of the chemical oxidation requirements. The effect of this addition causes a substantial portion of sodium bisulfate to be formed in the chemically oxidized waste, while also leaving a substantial slug of unreacted sodium persulfate in the sludge. The resulting chemically oxidized waste will contain ~47 wt% sediments. There are concerns that such a high sediment waste would be difficult to continue agitating in the reaction vessel, pump from the reaction vessel to the empty tank, and eventually re-suspend from the tank, in preparation for being mixed with stabilization agents. The current conceptual design assumes that the agitation and pumping equipment for the reaction vessel is sufficient to handle and maintain the waste slurry, while chemical oxidation (and cooling) is underway. In addition, it is assumed that the proposed MFJPMS is sufficient to re-suspend the chemically oxidized waste for eventual stabilization, after it has set in a tank for a period of time (awaiting sample confirmation). Of these three assumptions, the agitation and pumping system are expected to be low risks, while the MFJPMS re-suspension capacity is expected to be a moderate risk. Based upon the outcome of further testing, the current agitation system, and pumping systems, may have to be redesigned. If the assumption is invalid, there may be a need to eliminate waste consolidation, prior to mixing with stabilization agents. If laboratory tests indicate that the sodium persulfate step is not needed to fully oxidize the oil-phase portion of the waste, these risks diminish.

3.10.7 Cracking and Expansion in the Stabilized Waste Form

The substantial volume of sodium persulfate needed to chemically oxidize the oil-phase portion of the waste results in a total sulfate concentration of over 50 wt%, prior to stabilization. Research on stabilization, grouting a sulfate concentration over 15 wt% is expected to cause substantial cracking and fracture of the resultant monolith (due to expansion upon the formation of gypsum and ettringite minerals). This would be a substantial problem if the waste acceptance guidelines demanded a monolithic waste form. However, the Waste Acceptance Criteria for the ICDF only requires the waste to be solid (not monolithic), while meeting LDRs. Since the proposed chemical oxidation process is expected to lower hazardous organic concentrations below regulatory levels (prior to stabilization), and the leachability of mercury in the consolidated liquid wastes is expected to already be below regulatory levels (prior to stabilization). It is expected that solidification of the waste, with the proposed grout will maintain its solid nature while passing LDRs, even if substantial cracking and fracture of the waste monolith occurs. It is assumed that stabilization of the chemically oxidized, high-sulfate, waste can be performed without impacting the waste form’s capability of meeting the ICDF WAC. The stabilization formula has been modified to include a high concentration of blast furnace slag (good for high sulfate concentrations), along with sulfate-resistant cement. The expanding nature of the grout could fracture the containers that it is placed in, prior to disposal at the ICDF. Further studies are required to investigate this phenomenon.

The items detailed above and several others noted throughout the design description require further testing and analysis in future design efforts.

3.10.8 The Possibility of a Runaway Reaction

The most probable technical uncertainty is associated with the potential for a "runaway" reaction during chemical oxidation, causing significant increases in reaction rate, resulting heat evolved, and vaporization temperature. The potential for a runaway reaction occurring during chemical oxidation can be seen by looking at the reaction rates previously recorded for Fenton's reagent oxidation of tank wastes at the Oak Ridge National Laboratory containing organic ion exchange resins, as a function of temperature. At a temperature of 60 C, the measured reaction rate constant for the reaction is 0.025/min. At 70 C, the rate goes up to 0.05/min. At 75 C, the rate goes up to 0.25/min. At 80 C, the rate rises to 0.525/min. At 84 C, the rate constant rises to 0.725/min. At 88 C, the rate constant goes to 0.85/min. And at 100 C, the measured rate constant was 1.1/min.

Little is known of the effect of temperature on reaction rate for Fenton's reagent oxidation of V-tank wastes. Lab-scale testing is currently underway to evaluate this effort. However, if the results indicate similar increases in reaction rate as shown above, as a function of temperature, the title design effort may need to change the operating temperatures for Fenton's reagent oxidation to temperatures closer to that of the boiling temperature of the V-tank slurries (approximately 95 C). Operation at these high temperatures could be performed at a similar rate as proposed for the conceptual design, while keeping the excess oxidant in the tank at a level substantially reduced from that required for the conceptual design. It is for these reasons that Oak Ridge National Laboratory has decided to proceed with high temperature Fenton's reagent oxidation, contrary to standard Fenton's reagent oxidation conditions.

For conceptual design purposes (low temperature operations below the boiling point of the solution), there needs to be strong temperature controls in place to keep the chemical oxidation reaction occurring at a specific set temperature, at all times. For instance, the need for 40 kW of cooling capacity on each 88-116 gal chemical oxidation batch, while adding 50 wt% hydrogen peroxide to the batch at a rate of only 265 ml/min. If cooling capacities are insufficient enough that even a 5°C temperature rise is experienced during chemical oxidation, the result could be a 30%-400% increase in the rate of chemical oxidation experienced (depending on what specific temperature rise is experienced), and an accompanying 30-400% increase in the amount of latent heat produced by the increase rate of reaction. The sudden increase in latent heating will further accelerate the rate of temperature increase experienced in the reaction vessel, in turn causing an even more rapid reaction and evolvement of heat, up until boiling temperatures are experienced.

While it also should be stated that a runaway reaction will be terminated as all of the excess oxidant is consumed, it is expected that the potential excess oxidant in a reaction may be sufficient to not provide enough of a control measure, should such a runaway reaction start. Quenching the reaction with water, to slow runaway reactions, may also not be enough if the reaction rate has more than quadrupled. The effect of this water will reduce oxidation concentration substantially (depending on the volume of the quench, relative to solution volume, while also dropping the solution temperature substantially. However, if the combined temperature drop/concentration drop is not sufficient to return the system to below original operating conditions, supported by the design cooling capacity, the solution could eventually return to the excessive rate of reaction experienced prior to quenching, with no additional volume available for further quenches. For this reason, it may be desirable to design the cooling and off-gas systems to withstand operating temperatures up to boiling. Further evaluation of runaway reaction potential will be developed as part of the title design effort.

4. PROJECT COST

A revised Project Support estimate has been prepared for this conceptual design. It is understood and recognized that the technology and processes required to perform the work are dynamic in nature and rapidly evolving. The purpose of this estimate is to provide an "updated" planning position for the project. The estimate is not intended for use in funding determination. It has not been subjected to the rigor of a formal jury review nor has an additional contingency analysis been performed. Both of these actions will be performed at the conclusion of the estimate addressing the 30% design where funding for the process will be determined. Because the original project support effort was based on information of an extremely high level, it is intended that performance of this estimate will create an intermediate record of the costs associated with performance as we currently define it. It is recognized that the most probable direction for the project will not be completely identified until the results for cold bench tests are completed. These should be completed prior to the commencement of the 30% design package and will be reflected in that estimate. The estimate for the 30% design will also serve as the "funding determination" estimate complete with jury review and contingency analysis. The contingency level identified in the original Technical Evaluation Report (TER) Project Support estimate has been carried forward to this estimate. The process used in developing the original contingency and the contingency which will be applied to the 30% design estimate are described in the following section.

4.1 Cost Risk/Contingency Analysis

Standard procedures for the preparation of an estimate require the inclusion of contingency to address possible, but unlikely or unplanned events; therefore, contingency dollars have been included in this estimate.

Contingency to cover the risks associated with this project and level of estimate has been included at rates derived from a risk analysis. The overall contingencies for this estimate were calculated based upon percentages that are a weighted average of the individual component contingencies within the estimate. These individual contingencies range from a lower value where the project team felt the risks would be non-existent to minimal, to a higher value for the higher risk areas of the project. These values, as the identified range, represent the project team's subjective determination of the risks inherent in the different levels of the estimate and the values recommended for these risks.

A risk application tool was used to arrive at the contingency used for this estimate, which linked the Success estimating software with @RISK risk analysis software. In the @RISK program, the key estimated cost summary levels were assigned low and high values. These values represent possible variations in the final cost of that level, and a degree of confidence in the accuracy and completeness of the information provided to the estimator. These bounding values were then run through a Latin Hypercube sampling simulation 2,000 times to arrive at the additional money required to address risk at various levels of confidence. The risk output is shown both tabularly and graphically. The calculated risk amounts, represented as percentages of the appropriate levels, were applied to the estimate levels to give the most-likely cost including risk. These risk analyses for an 85% confidence level resulted in the overall contingencies that are reflected in the summary sheets of the estimates.

4.2 Cost Summary

A data recapitulation, a project summary, and a detailed cost estimate are provided in Appendix D. A total estimated cost summary table is shown below.

Table 22. Total Estimated Cost.

Estimate Element	Estimate Subtotal	Escalation	Contingency	Total
Total Estimated Cost (TEC)	$13,435,644	*11.86%* $1,593,227	*51.21%* $7,696,609	$22,725,480
Total Estimated Cost (TEC)	**$13,435,644**	***11.86%*** **$1,593,227**	***51.21%*** **$7,696,609**	**$22,725,480**
Rounded TEC (rounded to the nearest $100,000)				**$22,700,000**

5. PROJECT SCHEDULE

Figure 16 is the planned path forward for the V-Tanks remediation project. Based on the current schedule, the V-Tank waste will be consolidated into two tanks during the summer of 2004. The MSA and SO testing will begin in the spring of 2005 and the remedial action (treating and disposing of the waste) will take place during the summer of 2005.

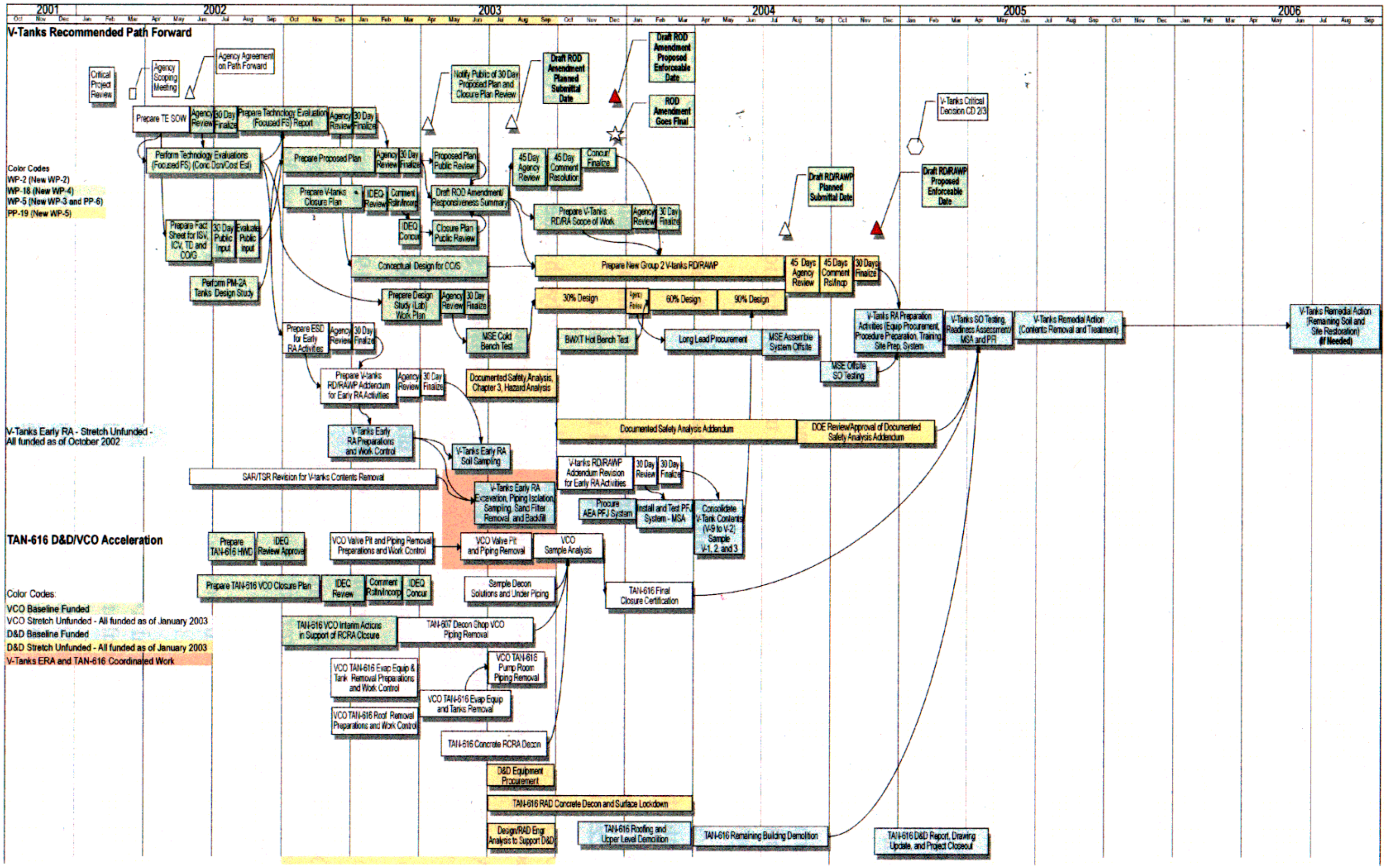

Figure 16. V-Tanks Project Schedule.

6. PROJECT PLANNING AND ASSESSMENTS

6.1 Design Requirements

The following design requirements, along with the Technical and Functional Requirements, served as a basis for the decisions made in conceptual design.

Assessments and Planning for major activities address:

- ESH&QA
- Safeguards and Security
- Criticality
- Project Risks

6.1.1.1 General Design Requirements

- Tank consolidation activities will performed in 2004. The subsequent chemical oxidation/reduction/stabilization will be performed in 2005.
- The AGTST shall be a 6,500-gallon high-density polyethylene container.
- Compressed air shall be provided for use by the MFJPMS.
- Peristaltic Hose pumps will be used for removing the "heel" from the sump area of the V-Tanks. Moyno grout pumps will be used to transport the oxidized waste back to the V-Tanks from the reaction vessels.
- Access to the tank sump area shall be made available for complete emptying V-Tank contents.
- Only one camera per nozzle is required. The cameras will be deployed with the MFJPMS nozzle inside the tank where waste removal is occurring.
- Disposal containers shall be 550-gallon high-density polyethylene containers capable of holding grouted contents and handling any grout expansion concerns.
- A ribbon mixer shall be used to mix the oxidized waste and grout mix in batch size not to exceed the capacity of the disposal container.
- Mixing/Transfer of V-Tank contents will utilize the MFJPMS.
- Excavation work shall comply with OSHA Standards part 1926, Subpart P.
- Drainage Control shall be provided for the work area to control surface runoff in accordance with INEEL Storm water Pollution prevention policies. Site grading shall incorporate the existing area drainage plan.
- A temporary 4-foot high construction fence shall be provided around the project work site for access control.
- Radiation shielding shall be provided by temporary shielding methods such as lead blankets, bricks or barriers in conformance with ALARA guidelines.
- Secondary containment must be provided for the process equipment, piping, storage tanks, and grouted container interim (curing) storage area. Grouted containers that have cured (no

free liquids) do not require secondary containment. The secondary containment system shall be designed in accordance with 40 CFR 264.193(b).

- Containment Tents shall be provided over the processing equipment to prevent the spread of contamination and provide protection from the weather. Containment tents shall be designed in accordance with MCP-198, Large Area Containments.
- The MFJPMS must be capable of re-suspending the chemically oxidized waste (47 wt% sediments) prior to mixing with grout.
- Structural design for temporary enclosures and structures shall comply with ASCE-7, the DOE-ID Architectural Engineering Standards, and DOE-STD-1020 as applicable.
- Wind design shall be based on ASCE-7 with a Basic wind speed of V =96 mph (3-second gust), Importance Factor 1, Wind Exposure Category C.
- A ground snow load of Pg=35 psf shall be used with ASCE-7 calculations.
- Equipment components will be assembled prior to operations and SO tested. Detailed testing will be performed away from the operations area.
- Process operating baseline will be determined in the SO test.
- There is no instrument redundancy required except on the reaction vessel (Ph, Level, Cl, and Temperature).
- Only secondary wastes (F001) that meet land disposal restrictions (LDRs) are considered for disposal on-Site at the INTEC CERCLA Disposal Facility (ICDF).
- Secondary wastes (F001) that do not meet LDR and that cannot be practically treated on-Site, per the treatment alternative flow sheet, will be sent off-Site for treatment.

6.1.1.2 Pipe and Fittings Requirements

- All piping will be 304L Stainless Steel, SCH 40 unless noted otherwise.
- All piping involved in moving V-Tank contents and oxidized waste shall be selected for minimum corrosion during operation.
- The off-gas piping from the reaction vessels to the demister shall be corrosion resistant.
- All pipe fittings shall be SCH 40, Stainless Steel unless noted otherwise.
- Flanges and valves shall be rated at 150 pounds minimum.
- Flexible hoses shall be used where hook-up and maneuverability concerns require it.
- All hoses and fittings shall be poly sleeved (i.e., Bartlett Services, Inc. Super Sleever) to meet double containment requirements.

6.1.1.3 Reaction Vessel Design Requirements

- Reaction vessels shall have capability to heat contents to 100°C and cool contents to 20°C (Heating-150 kW capacity, Cooling-100 kW capacity with 40 kW applied to each reaction vessel simultaneously).
- Reaction vessels must include the capacity to intimately mix the solid and liquid wastes with the chemical oxidizing agents. Each vessel will have an agitator capable must be capable of mixing material with a density of 1.77 gm/ml with a sediment concentration of 47 wt%, and a water concentration of only 28 wt%.
- Reaction vessels shall be at least 500 gallons in capacity to accommodate the oxidation batch size and recipe along with up to 100% volume increases due to potential foaming during the oxidation process.
- Reaction vessels must be glass-lined to resist corrosion from the low pH, elevated temperature, high chloride concentration solution to which it will be exposed.
- An electric heater will heat the heat transfer fluid used in the waste heating operation
- A 200-gallon quench tank filled with water shall be positioned above each reaction vessel to be used in the case of power failure and the reaction must be diluted to curtail further reaction.
- A chiller capable of cooling the reaction vessel contents to 20°C shall be purchased separately and connected to the reaction vessel heating/cooling system.

6.1.1.4 Oxidation Requirements

- VOCs, BEHP, and PCBs in the waste must be oxidized to concentrations below the UTS limits. A suitable oxidizing agent, such as Fenton's reagent (hydrogen peroxide oxidizing agent catalyzed by cuprous and ferrous or ferric ions to accelerate the rate of waste oxidation and minimize the amount of hydrogen peroxide that decomposes during oxidation at elevated temperatures) must be used for this purpose. Sodium persulfate is sufficient to oxidize the residual VOCs not expected to be oxidized by Fenton's reagent to levels sufficient to meet UTS.
- The degree of hydrogen peroxide decomposition will stay below 43% during hydrogen peroxide additions.
- The chemical oxidant addition system will be capable of adding 50 wt% of hydrogen peroxide at a rate of 265 ml/min, and dry sodium persulfate at a rate of 1.6 kg/min.
- Prior to chemical oxidation of the waste via Fenton's reagent, the waste batch must be adjusted to an initial pH of 4 using a suitable acid such as nitric acid. During the Fenton's reagent oxidation the solution must be kept at a pH of 3-5 to prevent precipitation of $Fe(OH)_3$ and catalytic decomposition of hydrogen peroxide to oxygen, which may potentially create a hazardous environment. Oxidation via Fenton's reagent will produce hydrogen chloride, which will decrease the solution pH. To maintain a pH in the desired range of 3-5 during waste oxidation, a suitable neutralizing agent, such as sodium hydroxide, must be added to neutralize hydrogen chloride that is formed.

- Use of appropriate chemical mixing procedures and chemical anti-foaming process additives must be implemented to prevent excessive foaming during waste oxidation.
- Prior to chemical oxidation of the waste via sodium persulfate, the waste batch must be adjusted to an initial pH of 3-4 using a suitable acid such as nitric acid.
- The sodium persulfate shall be provided in 550-gallon containers. The persulfate hopper shall be located such that the persulfate can be transferred to the reaction vessels by using a flexible screw conveyor (or similar delivery system).
- Oxidized material must be neutralized to a pH of 7-9 and cooled to 20°C prior to being returned to V-Tanks for storage prior to stabilization
- The presence of sediments in the waste will not lower reaction rate constants significantly below 0.1/min for peroxide on regulated organics, and 0.004/min for persulfate on oil.
- All the chemical additive systems except HNO3, NaOH, and the anti-foaming agent fail to closed in the event of a power outage.
- GAC debris will be sent offsite to a permitted storage facility for disposal.
- Unoxidized VOCs volatilized during elevated temperature waste oxidation must not be released from the process. All system off gas will flow through GAC bed to capture VOCs in the process off gas stream. The condenser, located upstream of the GAC will minimize the amount of VOCs in the absorbed by the GAC bed by recycling the condensate back to the reaction vessel for treatment.
- Process sampling and analysis must be performed to aid in the operation of process equipment and ensure that waste oxidation has been completed to levels sufficient to comply with regulations
- All system off gas must flow through a sulfur-impregnated granulated activated carbon, or SGAC, bed to capture mercury in the process off gas stream. The purpose of the S-GAC is to minimize mercury monitoring requirements while providing GAC backup in the event of breakthrough.
- Oxidized waste must have an alkaline pH prior to being stabilized. An alkaline pH will assist in the activation of the grout additives such as blast furnace slag.

6.1.1.5 Off Gas System Design Requirements

- Condenser:

- liquid to air heat exchanger
- corrosion resistant material
- inlet gas flow less than 6 scfm at 80°C and –1.0" w.c. (12.2 psia)
- Operating temperature for outlet gas must be 40-65°F (5-18°C) using a chilled water, glycol or refrigerant based chiller/condenser subsystem. The chiller must maintain a cold coolant supply to the condenser with a nominal 20°F (6.7°C)

approach temperature (e.g. 20-45°F). Final operating temperatures and equipment selection will be based on title design activities.

- condensate temperature less than 5°C (41°F)
- inlet cooling fluid temperature 1.67°C – 7.2°C (35°F - 45°F)
- condensate generation rate 62 ml/min (0.02 gal/min).

- Condensate tank:

- corrosion resistant,
- operating temperature 5°C (41°F)
- capability to monitor liquid level
- nominal capacity 50 gallons, sufficient to accommodate collected condensate for 24 hour period at approximately 0.02 gal/min (62 ml/min)
- commercial grade procurement
- protected from leaks via a spill pallet.

- Condensate pump:

- centrifugal pump, bronze impeller or better,
- maintenance to include capability for unit replacement,
- Intermittent operation,
- capacity less than 20 gpm at less than 30 psi,
- single speed on/off control,
- ½ horsepower single phase 120 Volt,
- commercial grade procurement
- protected from leaks via a spill pallet.

- Mist eliminator

- moderate efficiency mist elimination,
- less than 4" w.c. dP

- Reheater

- heating of incoming air and incoming air flowrate sufficient to maintain HEPA banks at 20-40°F above the dewpoint.
- redundant heaters to ensure reheat capability.

- Reheater HEPA bank

- prefilter and HEPA filters meeting INEEL A-E standards for HEPA filtration,
- testable in-place filters to verify HEPA efficiency.

- Main HEPA bank

- prefilter and HEPA filters meeting INEEL A-E standards for HEPA filtration,
- testable in-place filters to verify HEPA efficiency.

- Dust Filter

- medium efficiency particulate collection,
- low pressure drop,

- Off gas blowers
  - continuous duty rating
  - sealed units
  - three month operation, minimum 5 year design life
  - capacity 100-150 scfm at 100°F and 5000 feet elevation
  - single speed on/off control with manual damper control for fine tuning
  - 3 phase 480 volt power
  - commercial grade procurement.

- A stack shall be included for the off gas. The stack will be made of 4" nominal diameter SCH 10 304L stainless steel pipe and shall be structurally secured to the off gas skid.

6.1.1.6 Stabilization Requirements

- A cementitious stabilization agent will be used to stabilize the oxidized V-Tank waste.
- Oxidized waste must have an alkaline pH prior to being stabilized.
- The grout must pass leachability testing (TCLP)
- The waste form must not contain free liquids
- The waste form must not expand to the point that it bursts open containers prior to or during shipping (which could occur up to one year after mixing).
- The stabilized waste form must meet Land Disposal Restrictions and remain solid.
- Stabilized waste will be contained in 550 gallon high density polyethylene tanks.
- High sulfate concentration in the waste following oxidation via sodium persulfate requires the use of a special sulfate resistant grout formulation.
- The formula for the grout is 80% blast furnace slag and 20% Type V Portland cement. The specific formula needs to be determined from bench scale studies.
- Stabilized waste will be staged for up to one year prior to shipment to ICDF
- Stabilized waste must not expand and burst storage container prior to or during shipping.
- Oxidized waste will be returned to the V-Tanks and stored for up to three months prior to stabilization.
- Stabilization of waste will require mixing of one part grouting additives to 0.6 parts aqueous phase (mass basis)
- Dry grout mix will be transferred to the ribbon mill by using a flexible screw conveyor (41/2 inch diameter and up to 40 feet in length).

6.1.1.7 Electrical Design Requirements

- A diesel generator will furnish main power.
- A second generator will provide backup power to monitor the system and bring the system to a safe shutdown.
- Generator output must provide 480VAC three phase and 120VAC single phase power.
- Electrical wiring will meet NFPA 70 (National Electric Code).
- All power wiring must be in rigid conduit.
- Minimum back-up power is required for safety and a controlled shutdown.
- No auto switchover to backup power is required.
- Area lighting is required for 24 hour, 7 day a week operation.
- All work areas will be illuminated with a minimum of 10 ft. candles.
- Stack radiation Constant Air Monitoring is required.
- Redundancy of instrumentation is not required, except on the reaction vessels.
- There will be no redundancy or backup of the computer system.
- One hour of control system operation from battery power is required for use in the event of a power failure.
- All instrumentation sensors must be protected from or be able to withstand the corrosive environment they are placed in.
- All data acquisition and control devices located with the process control equipment must be weather proof.
- All instrumentation must be calibrated prior to introduction of the waste stream into the system.

6.2 Codes and Standards

- **Civil/Structural**

- ASCE-7, minimum Design Loads for Buildings and Other Structures.
- AISC, American Institute of Steel Construction, Manual of Steel Design
- ACI-318, American Concrete Institute, Building Code Requirements for Structural Concrete.
- DOE-STD-1020, Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy.
- DOE-ID Architectural Engineering Standards.

- **Mechanical**

- DOE-ID Architectural Engineering Standards
- CERCLA requirements
- DOE Order 435.1
- DOT specification for shipping radioactive non-liquid waste

- HWMA/RCRA requirements
- BBWI MCP-540
- Land Disposal Restrictions (LDRs)
- TAN Safety Analysis Report (INEL-94/0163)
- ANSI N13.1 Equipment Design
- BBWI MCP-356, Routine Air Monitoring

- **Electrical**

- National Electrical Code (NEC)
- DOE-ID Architectural Engineering Standards
- CERCLA requirements
- DOE Order 435.1
- DOT specification for shipping radioactive non-liquid waste
- HWMA/RCRA requirements
- Land Disposal Restrictions (LDRs)
- TAN Safety Analysis Report (INEL-94/0163)

- **Chemical**

- DOE-ID Architectural Engineering Standards
- CERCLA requirements
- DOE Order 435.1
- DOT specification for shipping radioactive non-liquid waste
- HWMA/RCRA requirements
- Land Disposal Restrictions (LDRs)
- TAN Safety Analysis Report (INEL-94/0163)
- Code of Federal Regulations Title 29 - Occupational Safety and Health Standards
- Code of Federal Regulations Title 40 - Protection of Environment
- NACE Technical Standards
- IDAPA 58.01.01 - Rules for the Control of Air Pollution in Idaho.

6.3 Quality Assurance

6.3.1 Project Quality Assurance

Quality assurance implementation for the V-Tanks ES-CO/R/S will be based on the application of a graded approach. The levels of analysis, documentation, verification, and other controls are applied commensurate with an item's risk and importance.

TAN Clean Close Project managers will ensure that ES-CO/R/S activities are controlled and conducted per process-specific procedures that describe and control work processes applicable to design, fabrication, construction and operation of the ES-CO/R/S. If equipment is designed for ES-CO/R/S activities, personnel comply with QAPD design control. Each individual performing the work is responsible for ensuring that work processes are controlled and that they comply with established criteria. Managers are responsible for ensuring that workers have the correct procedures, materials, and training to perform quality work. All instructions and procedures will be maintained current with a documented and controlled method of revision. Instructions, procedures, and drawings will be readily available to ES-CO/R/S personnel at locations requiring their use.

Fabrication, installation, and inspection processes that have an effect upon the quality of items or services important to safety will be controlled by process procedures. The chemical oxidation process is a special process that will be controlled under a QPP and the process will control by the use of validated procedures. Personnel performing oxidation will be trained and qualified.

6.4 Radiological Evaluation

Radiological evaluations and controls will include an ALARA Review prepared by Radiological Engineering defining radiological hazards involved, as known, with the project and proposed mitigations and work controls. These controls, and others, will be included in a job specific RWP along with any work control evaluation points and limiting conditions that will control changing or unplanned conditions as work progresses. These documents and the work control document will be reviewed by the TAN facility ALARA Committee, and considering the high radiological risk involved with these activities, review by the Site INEEL ALARA Committee.

6.5 Source Term and Shielding Analysis

The source term for exposure and shielding evaluations is taken from the mass balance sheets. Exposure estimates and/or shielding requirements are based on Microshield calculations to estimate exposure rates based on the various dimensions and construction material of project equipment. Preliminary exposure estimates have been conducted for the process equipment, (i.e., reaction vessels, equipment piping, off-gas collection and/or filtration equipment) and are also dependent on process equipment dimensions, layout, piping runs, materials of construction, etc. Workers will be positioned at the maximum distance available from the radiation sources.

Preliminary exposure estimates for the reaction vessel do not indicate the need for permanent shielding to be designed. Temporary shielding will be used for any areas of higher exposures. Radiological Control will provide constant monitoring and evaluate conditions and controls as they evolve (INEEL 2003b).

6.6 Safety Category

A safety category evaluation has been prepared for all structures, systems, and components of the remediation. The evaluation was performed in accordance with Management Control Procedure (MCP)-540, "Documenting the Safety Category of Structures, Systems, and Components". The project components have been evaluated as Low Safety Consequence (LSC).

6.7 Criticality

Criticality concerns associated with the TAN V-Tanks have been investigated (INEEL 2003a). Based on the small concentrations of uranium (U) and the volume of sludge in the V-Tanks, a criticality associated with removing and mixing existing material in the V-Tank system is not possible in any configuration.

Remediation efforts for the TAN V-Tanks have involved content characterization by sampling. Numerous samples from the V-Tanks have indicated that quantities of fissile material may be present in the tanks. The U in the tanks is comprised mostly of UO_2 and is combined with the sludge in the tanks.

If the material in the sludge is combined into one large tank, the concentration of fissile material will not increase. However, the mass of fissile material will be increased. The maximum concentration of uranium found in the V-Tanks is in the sludge at 1.9 g/l (plus one standard deviation) [for a dry SiO_2 system with a U-235 concentration of 1.9 g/l, an infinite mass of U-235 is required to achieve criticality]. Based on sampling data, the combined fissile material from tanks V-1, V-2, V-3, V-9, V-13, and V-14 (Tanks V-13 and V-14 are not included in this work scope) is less than 2 kg. In order for a criticality to occur with 2 kg of sludge, the concentration of material would have to be increased to 35 g/l. This would require an increase in concentration by a factor of 10. If acid is added to the tanks during remediation, the U may be dissolved into a solution. If a caustic is then added to the tank, the U may precipitate out. In order for a criticality to occur, the U would have to be preferentially concentrated. There are no mechanisms that could concentrate the U in the sludge if it is dissolved and the U precipitates out. Additionally, the remediation efforts will not involve a process that would preferentially extract the U from the tanks. Therefore, it is not possible for a criticality to occur.

During the removal of material from the V-Tanks, liquid from one tank may be pumped into another tank to mobilize the material in that tank prior to removal. Additionally, the material from all of the tanks may be consolidated into one large tank. The fissile material in the tanks is in an oxide form and is not soluble in water. Previous sampling data indicates that the U concentration in the liquid is insignificant (i.e. 0.0002 mg/g). Therefore, adding the liquid from one tank into another tank would not result in a significant increase in the fissile material content or concentration. By mixing the liquid into the sludge in the tanks, the concentration of U in the sludge will decrease, which will result in a less reactive system.

6.8 Safeguards and Security

The TAN area is controlled by a 6-ft high perimeter fence to control access to the site so only trained and authorized personnel are able to access the contaminated site. All personnel will access the site and leave the site through access controls that will be set up. Equipment access will be through the north end of the site. Equipment used onsite during the remediation is expected to remain onsite until remediation is complete.

Local site access will be controlled by 4 ft. high fencing and posting signs during the construction phase and operation phase.

6.9 Operational Risks

Potential operational risks were identified early in the conceptual design process. These risks were based upon a preliminary operational flow sheet that was developed at that time and is shown as Figure H-1 in Appendix H. The major operational activities were identified and discussed, and potential failures were brainstormed and identified. Preventive measures and possible actions were developed to mitigate the apparent operational risks that were identified. These risks were then considered during the evolution of the conceptual design process and form the basis for a number of the design decisions. This information was placed in matrix form and is presented as Table H-1 in Appendix H. There is little correlation between the operational risks identified in this section and the technical uncertainties identified in Section 3.10. Both sections should be reviewed carefully during the initial stages of design to determine proper mitigation.

7. REFERENCES

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DOE-ID, 2001, Comprehensive Remedial Design/Remedial Action Work Plan for the Test Area North, Waste Area Group 1, Operable Unit 1-10, Group 2 Sites, DOE/ID-10875, Rev. 0, November 2001

DOE-ID, 1999, Final Record of Decision for Test Area North, DOE/ID-10682, Rev. 0, October 1999.

DOE-ID, 1997, Remedial Investigation Feasibility Study (RI/FS) for TAN OU 1-10 at INEEL, DOE/ID-10557, Rev. 0, November 1997.

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INEL, 1994, Preliminary Scoping Track 2 Summary Report for the Test Area North Operable Unit 1-05: Radioactive Contamination Sites, Idaho National Engineering Laboratory, INEL-94/0135, Revision 0, October 1994.

INEEL Controlled Documents

INEEL 2003, Air Permitting Applicability Determination (APAD) 3-10, "TAN V-Tank Chemical Oxidation/Reduction with Stabilization Project", May 2003.

INEEL, 2003a, EDF-3477,

INEEL, 2003b, EDF 3719, 2003, "Exposure Estimates for TAN V-Tanks Ex Situ Treatment Shipping Containers" Rev. 0, Diverse Engineering Projects, May 2003.

INEEL 2003c, New Proposed Plan for the V-Tanks Contents (TSF-09 and TSF-18) at Test Area North (TAN) Operable Unit (OU) 1-10, April 2003

INEEL 2003d, EDF-3697, "Removal, Oxidation, and Grouting of Liquid Waste from TAN Tanks V-1, V-2, V-3, and V-9 WAG 1, OU 1-10", Rev. 0, Diverse Engineering Projects, May 2003.

INEEL 2002a, SAR-208, "Safety Analysis Report for the Test Area North Operations," Rev. 0, August 2002.

Conceptual Design Report for Ex Situ Chemical Oxidation/Reduction and Stabilization of the V-Tanks

Appendix A

Assumptions

General Assumptions

- The CDR scope addresses the removal and treatment of the V-Tank contents and not the removal, treatment, and disposal of the tanks themselves.
- TAN-616 will be removed down to its foundation by the time remediation is initiated. If the soils underneath TAN-616 require remediation, that remediation will not impact this project.
- All HEPA filters are assumed to be debris subject to macroencapsulation if found to be hazardous or not conforming to waste acceptance criteria. All GAC beds and S-GAC beds will be disposed of at an off site disposal facility. This assumption is used for secondary waste disposal and cost estimates.
- Operations will occur during the summer months. Three months will be allotted for processing using a minimum 5-day, 24-hr/day work week.
- Mercury in waste will not need to be retorted since the composite waste streams are not characteristically hazardous for mercury.

Tank Contents

- Historical sample data are representative of the physical properties of the sludge and the contamination to be encountered in all media.
- Residual liquid and/or sludge in the V-Tanks that cannot be removed by rinsing and pumping, will be addressed when the tanks themselves are removed and made ready for disposal. At that time the tanks will be treated as debris and will require cleaning the interior surfaces to a "clean debris surface" as defined in 40 CFR 268.45. The tanks will remain hazardous until decontaminated to a "clean debris surface". Because the hazardous organics, metals, and radionuclides are predominantly in the sludge, the decontamination solutions generated at a later time should be relatively low rad and easy to treat and/or be amenable to shipping off site for treatment.
- The tank sludge has not hardened to a cement-like form; the sludge can be suspended in water by mechanical action or low-intensity shear forces.
- Chemically oxidized waste, with 47 wt% sediments is re-suspendable by the MFJPMS.

Oxidation

- VOCs in the waste are dissolved in an oil phase of concentration near equivalent to that defined by total organic carbon data.
- Mercury is assumed to be in an oxidized state following chemical oxidation and the grout formulation is assumed to provide significant fixation of leachable mercury.
- Less than 43 wt% H_2O_2 decomposition is experienced at all times during oxidation with Fenton's Reagent.

- Required destruction efficiency for target organics that are strongly partitioned to the solid and oil phase can be achieved through wet chemistry oxidation. This assumption covers PCB, BEHP, TCE, PCE, etc.
- Fenton's reagent (H_2O_2, Fe catalyst) will be the first oxidizing agent implemented. Target CFTs for Fenton's reagent are the waste VOCs and SVOCs. Fenton's reagent will not have the oxidizing potential to oxidize the oils to the extent necessary. MSE testing will confirm or refute this assumption. Reaction rate constant for Fenton's Reagent is pseudo first order with reaction rate constant close to 0.1/min. Oxidation via Fenton's reagent will occur at temperatures of 40-80°C
- Sodium persulfate will be the second oxidizing agent implemented. Target CFTs for sodium persulfate are oils in the waste as well as VOC and SVOC remnants. Reaction rate constant for persulfate is pseudo first order (depending on oxidant concentration) with reaction rate constant close to 0.004/min at 80ºC. Oxidation via sodium persulfate will occur at temperatures of 80°C

Corrosion

- V-Tanks are constructed of stainless steel, currently not in an appreciably corroded state
- Chlorides in the oxidized waste returned to the V-Tanks will cause a minimum of corrosion in the tanks. Pitting and/or stress corrosion cracking of the tanks will be minimized by minimizing the temperature of the oxidized waste returned to the V-Tanks. The rate of chloride corrosion will be endurable when the oxidized waste temperature is 20°C or below.
- The rate of oxidation reactions with any residual organic compounds will be very slow at temperatures below 40°C. The slow rate of reaction will not result in significant heating of the oxidized waste returned to the V-Tanks. This will be verified through testing at MSE.
- All iron in the oxidized waste is in the +3 oxidation state
- No chromium in the oxidized waste is in the +6 oxidation state
- Nitrates will not be present in the oxidized waste returned to the V-Tanks in a concentration sufficient to prevent corrosion of the tanks via passivation of the stainless steel tank surfaces
- Elemental mercury will not be present in concentrations high enough to bind up chlorides and decrease the chloride corrosion potential. The bulk of the mercury present in the oxidized waste will be in the form of mercury (II) oxide, HgO.
- Fluorides are not present in the waste in quantities sufficient to corrode the glass lining of the reactor vessel.
- Oxidized waste chloride concentration of 1600 ppm (20°C, neutral or slightly alkaline pH) or lower would not likely present prohibitive V-Tank corrosion problems for exposure periods of up to 15 months.
- Corrosion testing will be performed at MSE prior to commencing actual waste treatment operations.

Stabilization

- Sulfate attack of Portland cement concrete causes the formation of ettringite and gypsum, two minerals associated with the expansion of cured concrete. However, the expansive properties associated with this are manageable and do not affect LDRs or liquid solidifaction.

Waste Characterization

- Waste in the V-Tanks has undergone previous RCRA characterization. The entire V-Tanks content is characterized as RCRA code F001, due to the spent halogenated solvent (TCE) used in degreasing. Other organics that are listed as hazardous constituents under F001, such as PCE and TCA, will require treatment per the F001 standard.
- Additional characterization activities will be undertaken prior to treatment to clarify the need to add additional characteristic waste codes and to confirm final LDR treatment requirements.
- Existing data is conservative for chlorides. Future data, if taken, will not substantially change the design.
- V-Tank waste is considered a single waste stream for the purpose of establishing treatment requirements. This assumption allows for the consolidation of V-Tank waste for the purpose of treatment.
- The V-Tank waste is classified as a non-wastewater and is assumed to be characteristically hazardous, which invokes the applicable list of underlying hazardous constituents. For example, PCBs require treatment to the LDR limit of 10 ppm and BEHP requires treatment to the LDR limit of 28 ppm for disposal of the primary waste form at ICDF.
- The oxidized and pH adjusted liquid waste can be successfully grouted to obtain a waste form that passes a filter test.
- The V-Tank waste can be treated to meet ICDF waste acceptance criteria

Appendix B

Technical and Functional Requirements for Removal, Treatment and Disposal of Liquid from TSF-09 Tanks V-1, V-2, and V-3 and TSF-18 Tank V-9 for WAG 1, OU 1-10

(TFR-222, Draft)

TECHNICAL AND FUNCTIONAL REQUIREMENTS FOR REMOVAL, TREATMENT AND DISPOSAL OF LIQUID FROM TSF-09 TANK V-3 FOR WAG 1, OU 1-10

1. INTRODUCTION

This technical and functional requirements (TFR) document was prepared in accordance with Idaho National Engineering and Environmental Laboratory (INEEL) Management Control Procedure (MCP)-2811. It contains the requirements applicable to the removal, treatment, packaging and disposal of contents from TSF-09 Tanks V-1, V-2 and V-3, and TSF-18 Tank V-9 located outside Test Area North (TAN)-616. The contents will be disposed of at the INEEL CERCLA Disposal Facility (ICDF). This TFR is in support of the OU 1-10 remedial action activity and will be referenced in an INEEL Engineering Change Form (ECF).

1.1 System Identification

The system is the temporary installation required for safely removing and treating the contents of Tanks V-1, V-2, V-3 and V-9 and preparing it for disposal at the ICDF.

1.2 Limitations of the Technical Functional Requirements

This TFR is limited to the development of the tools, equipment and methodologies necessary to remove and treat the contents from Tanks V-1, V-2, V-3, and V-9 and preparing it for disposal at the ICDF. It is not intended to define analysis or evaluation tasks that may be necessary as part of the design activity. Should these analysis efforts identify additional requirements necessary to guide or constrain the design, they will be added to the T&FR Document via the program change control process.

1.3 Ownership of the Technical Functional Requirements

The OU 1-10 V-Tank Remediation Project Manager is responsible for the technical contents of this TFR and shall review any changes to it. The waste disposed of will be in accordance with the ICDF Waste Acceptance Criteria (WAC) and with the approval of the ICDF facility manager.

1.4 Definitions/Glossary

V-Tanks – Refers to the tanks (V-1, V-2, V-3 and V-9) located underground outside of TAN-616.

1.5 Acronyms

ALARA	as low as reasonably achievable
ARAR	Applicable or Relevant and Appropriate Requirements
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	Contaminants of Concern
DOT	Department of Transportation
ECF	Engineering Change Form
ICDF	INEEL CERCLA Disposal Facility
INEEL	Idaho National Engineering and Environmental Laboratory
LDR	land disposal restriction
M&O	management and operating
MCP	management control procedure
RCRA	Resource Conservation Recovery Act
TAN	Test Area North
TFR	technical and functional requirements
TSR	technical safety requirement
WAC	Waste Acceptance Criteria
WGS	Waste Generator Services

1.6 Key Assumptions

- Equipment components will be assembled prior to operations and SO tested. Detailed testing will be off-site.
- The AEA system will be used to mix and remove tank contents.
- The GAC bed will be sized to handle all VOCs in a batch volume with change out as necessary.

- Safety category for equipment is LSC.
- Supernate or liquid from the other V-tanks will be use for sludge heel removal.
- Heel is “muddy water” – i.e. no heavy solids.
- The heel must be removed.
- The time permitted for processing will be two months in duration.
- Processing will be accomplished during non-freezing months.

2. OVERVIEW

2.1 System Functions

The overall function of this system is to remove, treat and safely dispose of the contents in Tanks V-1, V-2, V-3, and V-9 located at the TAN facility.

To accomplish this overall function the system must have the capability to:

- Slurry the liquid and sludge and remove from the V-tanks.
- Treat the waste to meet the ICDF WAC.
- Containerize the waste to meet ICDF WAC and DOT requirements.
- Stabilize the treated waste to meet ICDF WAC.
- Sample the grouted waste to verify compliance with the ICDF WAC.
- Prepare for transportation stabilized waste to the ICDF for disposal.

2.2 System Classification

This remedial activity has been categorized as Low Safety Consequence.

2.3 Operational Overview

The treatment and grouting system shall be located near the TAN V-tanks. The system shall be able to slurry and remove the V-tank waste in batches so that the treatment sub-system can efficiently process the waste. The slurried waste will be pumped to a reactor vessel where it will be treated by means of chemical oxidation or reduction. The treated waste will be placed into containers and samples taken and analyzed to ensure compliance with the ICDF WAC.

If the treated waste is not compliant, the treatment system will be reviewed and changes made to ensure compliance. The non-compliant waste will then be treated again and re-sampled to ensure compliance.

If the treated waste is in compliance, a stabilization agent will be mixed in with the treated waste for disposal at the ICDF. Samples will again be taken and analyzed to ensure the grouted waste is compliant with the ICDF WAC. The stabilized containers will be placed in a temporary holding area for loading and transportation to the ICDF.

The off-gas from the reactor vessel will be run through a condenser and demister with the condensate returned to the reactor vessel for further processing. The remaining off-gas will be monitored and filtered/treated, as necessary, to meet regulatory guidelines prior to being released to the atmosphere. Once the tank contents have been processed, the treatment and grouting system will be dismantled and dispositioned as deemed necessary.

3. REQUIREMENTS AND BASES

3.1 Functional and Performance Requirements

This section contains the functional and performance requirements necessary to meet the system functions described in section 2.1.

3.1.1 System

Other Requirement – Local operation shall be used except where remote is required for personnel exposure to radiation and other physical hazards.

Basis: The sludge/waste from the V-tanks contain sufficient hazardous contaminants to render treatment components difficult to work with. Reducing required handling would increase worker safety and decrease length of exposure.

Reference: Engineering judgment.

Verification: Design review.

Mission Critical – Standby/Backup power shall be provided.

Basis: In the situation power is cut to the treatment system, backup power will be necessary to either continue with the processing or to safely shut the system down until power can be restored.

Reference: Engineering judgment.

Verification: Design review.

Mission Critical – The system shall be designed such that the operation cycle will be complete in two months.

Basis: The project window for processing the waste allows for two months to complete.

Reference: Project schedule.

Verification: Design review.

Other Requirement – The system shall not be designed for winterization.

Basis: The time frame for processing this waste is during the non-freezing months.

Reference: Project schedule.

Verification: Design review.

Environmental Requirement – Capability shall be provided to treat the V-tank waste such that it can be disposed of at the ICDF.

Basis: The ICDF will not accept any product containing hazardous constituents above levels specified in the ICDF WAC. Treatment must remove all hazardous constituents from the liquid to the extent necessary to allow the grouted final waste form to meet the ICDF WAC and LDRs.

Reference: ICDF WAC, LDRs

Verification: Design review.

Mission Critical – The system shall have the capability to transfer the contents of tanks V-1, V-2, V-3, and V-9 to the chemical oxidation subsystem without leaving unacceptable heel residual.

Basis: The treatment system will be processing waste from all four V-tanks. In order to process the waste and prepare the V-tanks for disposal, all the waste and resulting heel must be removed.

Reference: Regulatory requirements, Engineering judgment.

Verification: Design review.

Environmental Requirement – Capability shall be provided to monitor and sample aqueous solutions and air emissions.

Basis: Sampling the aqueous solutions and monitoring the off-gases will aid in determining the level of completion of chemical oxidation/reduction. Monitoring off-gas emissions will also aid in determining compliance to regulatory standards.

Reference: Regulatory standards, Engineering judgment.

Verification: Design review.

Mission Critical – Capability shall be provided to maximize diffusion of COC's.

Basis: The efficiency of chemically oxidizing COC's depends on maximizing the contact of COC's with the oxidant.

Reference: Engineering judgment.

Verification: Design review, process monitoring.

Mission Critical – Waste containers shall be acceptable for transport to the ICDF.

Basis: DOT restricts types of shipping containers and their contents over public highways.

Reference: DOT Specifications.

Verification: Design review.

Other Requirement – Container labeling and tracking capability shall be provided for identifying and tracking containers in IWTS.

Basis: Samples will be taken and containers will need to be identified in the case sample data shows non-conformance with LDR levels and final oxidized waste form needs to be reprocessed.

Reference: MCP-3475

Verification: Field Sampling Plan (FSP), TPR

Other Requirement – Material selections shall be made based on a one year operating life and two year mothballed life for the temporary equipment used in this system and based on the ICDF WAC for items to be disposed of at the ICDF.

Basis: The equipment used to treat, containerize, sample, and grout the waste from the V-tanks is expected to be in operation with actual V-Tank waste for two months. Waste containers to be disposed of at ICDF must meet the ICDF WAC.

Reference: Project schedule.

Verification: Design review.

Subsystem and Major Components

Sludge Removal Subsystem

Other Requirement – The sludge removal device shall provide sufficient suction lift to remove waste from the V-tanks while located at ground level and be predicated upon using the AEA system. The device shall provide sufficient discharge head to transfer the waste to the reactor vessel(s).

Basis: Tanks V-1, V-2 and V-3 are ~10' below ground level and the suction inlet will need to be up to ~10' below the top of the tank requiring a total of ~20'of suction lift. Tank V-9 is not as deep but the sludge contained in V-9 is slightly higher in density.

Reference: Engineering judgment.

Verification: Design review, mockup testing, SO testing.

Chemical Oxidation/Reduction Subsystem

Mission Critical – The reaction vessel shall be designed to facilitate both heating and cooling capabilities.

Basis: The oxidation process is more efficient at temperatures below boiling. Therefore, if the reaction becomes too hot the capability to cool the reaction vessel contents would be needed. The temperature range established for this design is 60 degrees F on the low end up to boiling.

Reference: Engineering judgment.

Verification: Design review.

Other Requirement – The reaction vessel shall be designed to run at near ambient pressure.

Basis: The oxidation/reduction process may be inhibited at pressures above ambient

Reference: Engineering judgment.

Verification: Design review.

Mission Critical – Capability shall be provided for addition of external constituents into the reaction vessel as needed.

Basis: Additional constituents, such as raw water or an acid or base for pH adjustments, may need to be added in order to optimize and control the oxidation/reduction process.

Reference: Engineering judgment.

Verification: Design review, SO testing.

Mission Critical – Capability shall be provided for mixing in the reaction vessel.

Basis: The sludge/waste must be held in suspension and the oxidants/reductants added must be mixed as uniformly as possible.

Reference: Engineering judgment.

Verification: Design review.

Environmental Requirement – The chemical oxidation/reduction subsystem shall provide sufficient treatment such that the oxidized/reduced waste will meet all requirements necessary for disposal at the ICDF.

Basis: The ICDF WAC and LDRs limit the amount of certain contaminants that can be disposed of there. The subsystem shall sufficiently remove the contaminants of concern to ensure acceptance at ICDF.

Reference: ICDF WAC, LDRs.

Verification: Design review.

Environmental Requirement – Capability shall be provided for real-time sampling and provide results indicating the oxidized batch is complete.

Basis: The treated waste must be sampled and the results used to verify the oxidized/reduced waste form, once stabilized, will be in compliance with the ICDF WAC before stabilization can proceed.

Reference: ICDF WAC.

Verification: Design review, SO testing.

Other Requirement – The chemical oxidation/reduction subsystem shall provide capability for re-treatment of the waste in the case sample results indicate contaminant levels exceed ICDF WAC acceptance levels

Basis: The ICDF WAC limits the amount of contaminants of concern to be disposed of at ICDF

Reference: ICDF WAC.

Verification: Design review.

Stabilization/Containerization Subsystem

Other Requirement – A temporary storage area with secondary containment shall be provided for containers with either treated waste or grouted waste.

Basis: The oxidized waste will need to be stored temporarily and safely at TAN while awaiting both sampling results and, after grouting, transport to ICDF. A CERCLA waste storage area will be designated by WGS.

Reference: CERCLA requirements, WGS, Engineering judgment.

Verification: Design review

Environmental Requirement – Capability shall be provided for secondary containment of the containerization subsystem.

Basis: It is conceivable through filling containers with treated waste that some spilling may occur. In order to not exacerbate contamination in the AOC, any leaks or spills must be contained and dealt with appropriately.

Reference: Engineering judgment

Verification: Design review

Environmental Requirement – The final stabilized waste form in its containers shall meet DOT requirements for shipping to ICDF or an exception developed acceptable to DOT.

Basis: This would allow utilizing DOT compliant packaging options. Exception to the DOT requirements could be taken by developing a transport plan demonstrating equivalent safety and briefly closing the section of Highway 33 between TAN and the INEEL boundary to the public during shipments.

Reference: DOT Specifications.

Verification: Design review.

3.1.2 Boundaries and Interfaces

This TFR covers the temporary units that comprise the system for processing the liquid and sludge TAN tanks V-1, V-2, V-3 and V-9. The major interfaces are:

The 20" nominal manhole in tanks V-1, V-2 and V-3.

The 6' diameter culvert forming the access pit from ground level ~ 10' below grade to the manholes of tanks V-1, V-2 and V-3.

The 6-inch nominal vent from ground level to top of tank V-9.

3.1.3 Codes, Standards, and Regulations

The system and TAN facility modifications required to implement this design shall comply with the codes and standards listed below:

- DOE-ID Architectural Engineering Standards
- CERCLA requirements
- DOE Order 435.1
- DOT specification for shipping radioactive non-liquid waste
- HWMA/RCRA requirements
- MCP-540
- Land Disposal Restrictions (LDRs)
- TAN Safety Analysis Report (INEL-94/0163)
- 10 CFR 830, Subpart A
- 10 CFR 835

Basis:Compliance with the codes and standards is dictated by law, the INEEL management and operating (M&O) contract, and good practice.

3.1.4 Operability

Not applicable – This is a temporary installation and will be removed when completed.

3.2 Special Requirements

3.2.1 Radiation and Other Hazards

None

3.2.2 As Low as Reasonably Achievable (ALARA)

ALARA practices shall be employed to minimize radiation exposure for all contact operations, including precautions near the V-tank openings. This may also include temporary shielding and/or spacing of temporary equipment or containers. Radiation contamination/radiological shielding and barriers shall be in place. Precautions shall be taken to ensure worker safety and ingress/egress points shall be established.

3.2.3 Nuclear Criticality Safety

Not applicable – Reference J. W. Nielsen letter to G. E. McDannel, "Criticality Issues Associated with the Removal And Storage of the Material from the TAN V-Tanks; V-1, V-2, V-3, and V-9," JWN-02-02, June 17, 2002.

3.2.4 Industrial Hazards

The Independent Hazard Evaluation Group process in STD-101 shall be used to address industrial hazards.

3.2.5 Operating Environment and Natural Phenomena

The system shall be suitable for outdoor operation at TAN during nonfreezing conditions including high winds and earthquakes.

3.2.6 Human Interface Requirements

All instruments, monitors, equipment, etc. shall be selected and positioned to enhance ease of use and be readily accessible.

Controls for processing the waste shall be easily accessible by the operator(s) and be designed for the safety of the operator(s) and the environment. Controls (technical or administrative) shall be utilized to ensure containers cannot be over filled.

3.2.7 Specific Commitments

Prior to use, all equipment and supplies used in the system to process the TAN V-tank waste shall have an approved disposal or usage path.

3.3 Engineering Design Requirements

3.3.1 Civil and Structural

N/A

3.3.2 Mechanical and Materials

Reaction vessels and associated components must be able to withstand a highly corrosive environment.

3.3.3 Chemical and Process

N/A

3.3.4 Electrical Power

All power shall be provided from a diesel powered electric generator. A second diesel powered electric generator will be provided for backup power.

3.3.5 Instrumentation and Control

Process control instrumentation shall monitor all critical process variables for control, recording and analysis. Control sensors shall be redundant only where determined to be critical to successful process operation.

3.3.6 Computer Hardware and Software

Computer hardware and software shall be used for process control only where local operator control is not practical. No redundancy of computer control hardware shall be required.

All software, whether commercially available or developed, shall be managed, developed and tested per MCP-550.

3.3.7 Fire Protection

Only portable fire extinguishers shall be provided since this is a temporary outdoor system involving no cutting (which would create sparks), welding, or flammable liquids or gases.

3.4 Testing and Maintenance Requirements

3.4.1 Testability

Initial assembly, testing and procedure writing shall be performed at another location prior to final assembly and check out at the tank site.

3.4.2 TSR-Required Surveillances

TBD

3.4.3 Non-TSR Inspections and Testing

TBD

3.4.4 Maintenance

Maintenance will be performed on an as-needed basis. This is a temporary installation with a brief operating duration and no routine maintenance is anticipated to be required.

3.5 Other Requirements

3.5.1 Security and SNM Protection

Not applicable.

3.5.2 Special Installation Requirements

Not applicable.

3.5.3 Reliability, Availability, and Preferred Failure Modes

Not applicable.

3.5.4 Quality Assurance

The system is considered to be Low Safety Consequence, but specific items may be evaluated according to MCP-540 and designated appropriately. See MCP-550 for software requirements and PLN-694 for Environmental Remediation QA requirements.

3.5.5 Miscellaneous

Not applicable.

4. APPENDIX A – APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

4.1 Compliance with ARARs

Implementation of the new remedy will comply with all ARARs. However, some ARARs identified in the 1999 ROD have been deleted and others added in this new remedy. Table 9-1 lists all ARARs from the 1999 ROD, changed ARARs , and newly identified ARARs for the new remedy.

4.1.1 ARARs Not Changed from the 1999 ROD

The following ARARs apply to the remedy as originally cited and described in the 1999 ROD:

- IDAPA 58.01.01.585 (Formerly 16.01.01.585), Toxic Air Pollutants, Non-Carcinogenic Limits

- IDAPA 58.01.01.586 (Formerly 16.01.01.586), Toxic Air Pollutants, Carcinogenic Increments, and the following, as cited in it:

  - 40 Code of Federal Regulations (CFR) 61.92, National Emission Standards for Hazardous Air Pollutants Standard (NESHAPS)

- 40 CFR 61.93, NESHAPS Emission Monitoring and Test Procedures

- IDAPA 58.01.01.650 and .651 (formerly 16.01.01.650 and .651), Rules for Control of Fugitive Dust

- IDAPA 58.01.05.006, Standards Applicable to Generators of Hazardous Waste, and the following, as cited in it:

  - 40 CFR 262.11, Hazardous Waste Determination

- IDAPA 58.01.05.008 (formerly 16.01.05.008) Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, and the following, as cited in it:

  - 40 CFR 264.114, Equipment Decontamination

  - 40 CFR 264.171-.178, Use and Management of Containers

  - 40 CFR 264.192-.196, and .197, Tank Closure and Post-Closure Care

- IDAPA 58.01.05.011 (formerly 16.01.05.011), Land Disposal Restrictions, and the following, as cited in it:

  - 40 CFR 268.40(a)(b)(e), Applicability of Treatment Standards

  - 40 CFR 268.45, Treatment Standards for Hazardous Debris

  - 40 CFR 268.48(a), Universal Treatment Standards

  - 40 CFR 268.49, Alternative LDR Treatment Standards for Contaminated Soil

- 40 CFR 300.440, CERCLA Off-Site Rule

- DOE Order 5400.5, Chapter II (1)(a,b), Radiation Protection of the Public and the Environment

- EPA, Region 10 Final Policy on the Use of Institutional Controls at Federal Facilities

4.1.2 ARARs That No longer Apply

The following ARARs cited in the 1999 ROD have been deleted, because they no longer apply:

- IDAPA 58.01.05.008, more specifically, 40 CFR 264.13 (a)(1-3), General Waste Analysis

- IDAPA 58.01.05.008, more specifically, 40 CFR 264.14, Security of Site

- IDAPA 58.01.05.008, more specifically, 40 CFR 264.15, General Inspections

- IDAPA 58.01.05.008, more specifically, 40 CFR 264.16, Personnel Training

- IDAPA 58.01.05.008, more specifically, 40 CFR 264.Subpart C, Preparedness and Training

- IDAPA 58.01.05.008, more specifically, 40 CFR 264. Subpart D, Contingency Plan and Emergency Procedures

The above ARARs are deleted and replaced by 40 CFR 264.1(j), General Standards Applicable to Remediation Waste Management Sites, which covers the equivalent topics.

4.1.3 Additional ARARs for the Newly-Selected Remedy

The following ARARs, not identified in the 1999 ROD, have been added:

- IDAPA 58.01.05.008, more specifically, 40 CFR 264.1(j), General Standards Applicable to Remediation Waste Sites (This ARAR replaces the ARARs deleted in Section 9.2.2).

- IDAPA 58.01.05.008, more specifically, 40 CFR 264.111, Closure Performance Standards

- IDAPA 58.01.05.008, more specifically, 40 CFR 264 Subpart AA, Process Vents

- IDAPA 58.01.05.008, more specifically, 40 CFR 264.553, Temporary Units

- IDAPA 58.01.05.008, more specifically, 40 CFR 264.554, Staging Piles
- 40 CFR 761.45, PCB Labeling Requirements
- 40 CFR 761.50(a)(7), PCB/Radioactive Waste Storage
- 40 CFR 761.65(b)(1)(i-iv) and (c)(1), PCB Storage Requirements

4.1.4 Clarification of ARARs

The Agencies have agreed to clarify ARARs that apply to the remedy as follows:

- Combined Waste Stream: All waste in Tanks V-1, V-2, V-3, and V-9 is considered one waste stream. Waste was typically routed through Tank V-9 for solids removal before distribution to V-1, V-2, or V-2, depending on available capacity. While the concentrations of specific hazardous constituents may vary from tank to tank, the average concentration of the hazardous waste constituents for all tanks will be used to determine the applicability of LDR treatment standards to the entire waste stream.

- The waste is currently characterized as a listed F001 waste under RCRA, with no other applicable waste codes. However, based on available sampling data, it is not possible to determine if characteristic "D" codes apply to the waste. Interference between compounds during the laboratory analysis of waste samples resulted in detection limits above the concentrations that would characterize the waste as "D"-listed. That means it is not possible to determine if the actual concentrations in the waste exceed the applicable limits. Until the additional planned sampling is completed, the Agencies will assume that the "D" characteristic codes are applicable. This means that the treatment system will be designed to meet the "D" code treatment standards and the Universal Treatment Standards (UTS) for all Underlying Hazardous Constituents (UHCs). This is in addition to the applicable F001 treatment standards. If the additional sampling effort demonstrates that the V-Tank waste does not exhibit any hazardous characteristic (no applicable "D" codes), then treatment goals will be modified to achieve compliance only with the applicable F001 treatment standard.

- The agencies have determined that the management of PCB remediation wastes will be modified in accordance with the ARAR, 40 CFR 761.61(c). Under TSCA, the combined liquid and sludge waste is considered a liquid PCB waste and, as such, is regulated as a PCB remediation waste. The waste acceptance criterion for PCBs at the ICDF is 500 mg/kg in the stabilized waste form. The V-Tank waste is below 500 mg/kg PCBs in the tanks today. After treatment and stabilization, the concentration of PCBs will be even lower. However, because it remains a PCB waste under TSCA, management of the liquid PCB remediation waste still requires approval under TSCA. The ARAR, 40 CFR 761.61(c), allows a risk-based petition showing the planned treatment for the V-Tank waste, the final disposition at the ICDF, and a demonstration of the acceptable risk resulting from management of the wastes according to this plan. This information required for this petition has been complied in an "Engineering Design File" that has been placed in the Administrative Record for OU 1-10 [REF].

- Volatile organic compounds, mercury, or other hazardous constituents released during the chemical oxidation/ reduction or stabilization processes and collected on activated carbon, sulfur-impregnated carbon, or HEPA filters is a new waste stream, with its own treatment requirements. These wastes will be characterized as F001, and further characterized to determine if it exhibits any of the characteristics of a hazardous waste. Applicable treatment standards will be assigned based on these characteristics. These wastes will be tested to determine if they meet applicable LDR treatment standards, and they will be treated, as appropriate, after treatment of the V-Tanks waste.

- The Agencies have agreed that the CERCLA Off-Site Rule will be interpreted as follows:

Table 4-1. Summary of ARARs for the New V-Tank Remedy

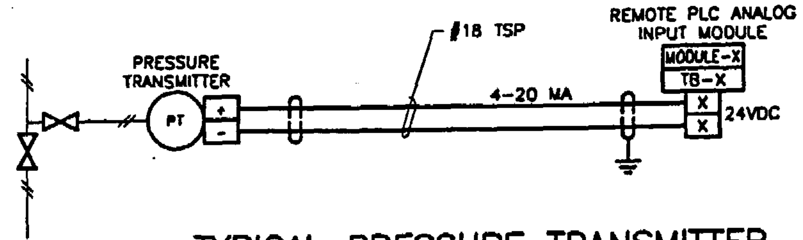
Requirement (Citation)	ARAR Type: Action Specific	Chemical Specific	Location Specific
Clean Air Act and Idaho Air Regulations			
Idaho Air Pollutants- Toxic Substances IDAPA 58.01.01.161 (formerly IDAPA 16.01.01.161)		A	
Idaho Air Pollutants-noncarcinogens IDAPA 58.01.01.585 (formerly IDAPA 16.01.01.585)		A	
Idaho Air Pollutants- carcinogens IDAPA 58.01.01.586 (formerly IDAPA 16.01.01.586)		A	
NESHAPS- <10 mrem/yr 40 CFR 61.92		A	
NESHAPS-Monitoring 40 CFR 61.93	A		
NESHAPs-Emissions Compliance 40 CFR 61.94(a)	A		
Idaho Rules for Control of Fugitive Dust IDAPA 58.01.01.650 and .651 (formerly IDAPA 16.01.01.650 and .651)	A		
Requirements for Portable Equipment IDAPA 58.01.01.500.02 (formerly IDAPA 16.01.01.500.02)	A		
RCRA and Hazardous Waste Management Act			
Generator Standards			
IDAPA 58.01.05.006 (formerly IDAPA 16.01.05.006)	A		
Hazardous Waste Determination 40 CFR 262.11	A		
Manifest 40 CFR 262 Subpart B	A		
Pre-Transportation Requirements 40 CFR 262.30-.33	A		
General Facility Standards			
IDAPA 58.01.05.008 (formerly IDAPA 16.01.05.008)	A		A
General Waste Analysis 40 CFR 264.13 (a)(1-3)	A		
Security of Site 40 CFR 264.14	A		
General Inspections 40 CFR 264.15	A		
Personnel Training 40 CFR 264.16			
Preparedness and Training 40 CFR 264.Subpart C	A		
Contingency Plan and Emergency Procedures 40 CFR 264. Subpart D	A		
General Standards for Remediation Waste Sites 40 CFR 264.1(j)	A		
Closure Performance Standards 40 CFR 264.111	A		
Equipment Decontamination 40 CFR 264.114	A		
Use and Management of Containers 40 CFR 264.171-.178	A		
Tank Closure and Post-Closure Care 40 CFR 264.192-.196 and .197(a)	A		
Temporary Units 40 CFR 264.553	A		
Staging Piles 40 CFR 264.554	A		
Process Vents 40 CFR 264, Subpart AA	A		
Land Disposal Restrictions			
IDAPA 58.01.05.011 (formerly IDAPA 16.01.05.011)	A		
Applicability of Treatment Standards, 40 CFR 268.40(a)(b)(e)	A		
Treatment Standards for Hazardous Debris 40 CFR 268.45	A		
Universal Treatment Standards 40 CFR 268.48(a)	A		
Alternative Treatment Standards for Contaminated Soil 40 CFR 268.49	A		
Toxic Substance Control Act (TSCA)			
PCB Labeling Requirements 40 CFR 761.45	A	A	
PCB/Radioactive Waste Storage 40 CFR 761.50 (a)(7)	A	A	
PCB Storage Requirements 40 CFR 761.65(b)(1)(I-iv) and (c)(1)	A	A	

Requirement (Citation)	ARAR Type Action Specific	Chemical Specific	Location Specific
PCB Remediation Waste 40 CFR 761.61(b)(1)	A	A	
Decontamination Standards and Procedures 40 CFR 761.79(c(1) and (2)	A	A	
Decontamination Solvents 40 CFR 761.79(d)	A	A	
Limitation of Exposure and Control of Releases 40 CFR 761.79 (e)	A	A	
Decontamination Waste and Residuals 40 CFR 761.79(g)	A	A	
CERCLA			
CERCLA Off-Site Rule 40 CFR 300.440	A		
To-Be-Considered			
Radiation Protection of the Public and the Environment, DOE Order 5400.5, Chapter II(1)(a,b)	A		
EPA Region 10 Final Policy on Institutional Controls at Federal Facilities	A		

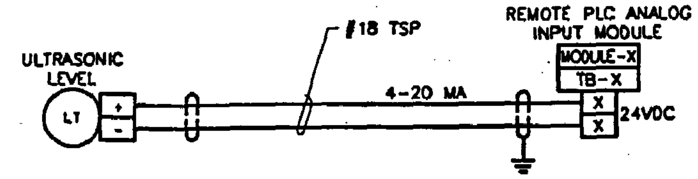
Key: A=applicable requirement; R= relevant and appropriate requirement

Appendix C

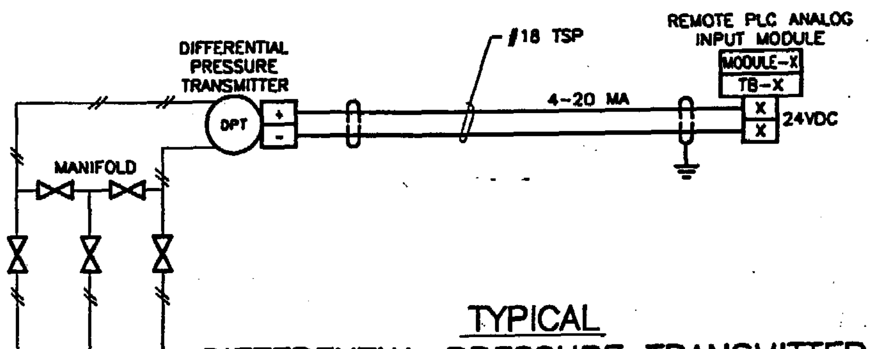
Conceptual Engineering Drawings



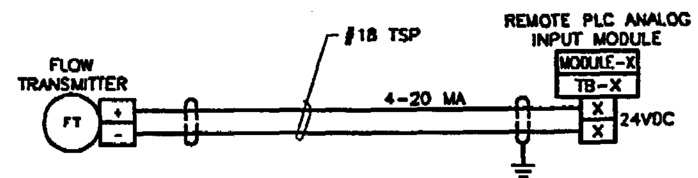
TYPICAL PRESSURE TRANSMITTER LOOP DIAGRAM



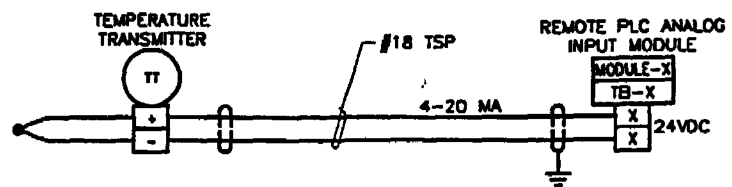
TYPICAL LEVEL TRANSMITTER LOOP DIAGRAM



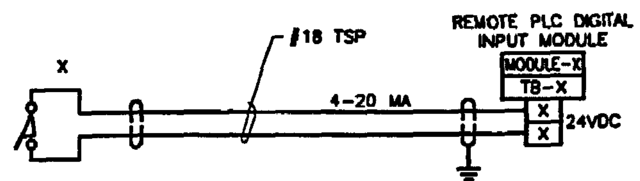
TYPICAL DIFFERENTIAL PRESSURE TRANSMITTER LOOP DIAGRAM



TYPICAL FLOW TRANSMITTER LOOP DIAGRAM



TYPICAL TEMPERATURE TRANSMITTER LOOP DIAGRAM



TYPICAL DIGITAL INPUT LOOP DIAGRAM

NOTES

1. FOR PIPING AND INSTRUMENTATION DIAGRAMS SEE SHEETS P-1 THRU P-4.

REVISIONS: REV | DESCRIPTION | EFFECTIVE DATE

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REQUESTER: G. MCDANELL
DESIGN: SCOTT ALLEN
DRAWN: F.A. HAYNER
PROJECT NO. 22901
SPEC CODE
NO SCALE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
DESIGN PHASE: CONCEPTUAL
SAFETY CATEGORY: CG
EFFECTIVE DATE:

INEEL

EX SITU CHEMICAL OXIDATION/REDUCTION/STABILIZATION OF THE V-TANKS AT TEST AREA NORTH OPERABLE UNIT 1-10
TYPICAL LOOP DIAGRAMS

SIZE D | CAGE CODE 01MF3 | INDEX CODE NUMBER: AREA 034, TYPE 0400, CL 28, DISC 090 | DWG- | REV
SCALE: NONE | SHEET IN-1

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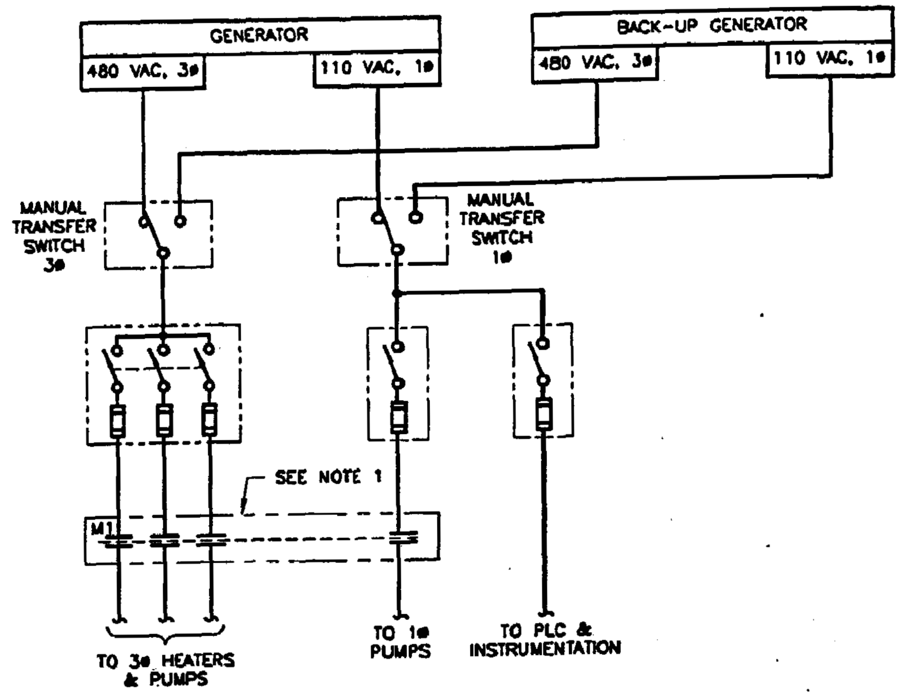
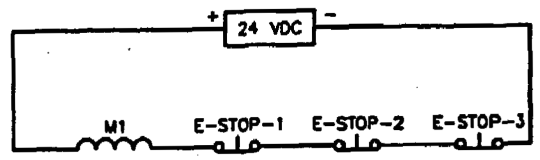
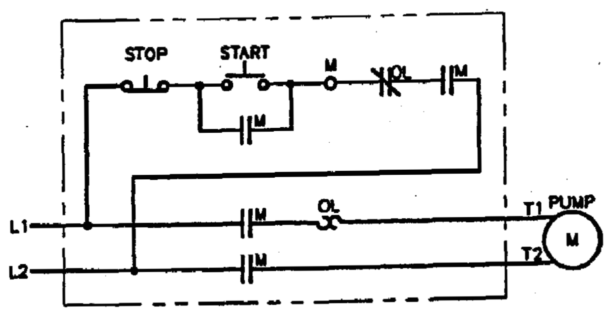


TEMPORARY POWER DISTRIBUTION

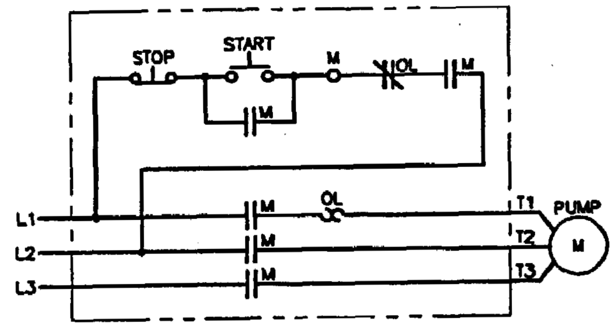


TYPICAL
EMERGENCY-STOP SCHEMATIC



LOCAL OPERATOR ACTUATED
PUSH-BUTTON MOTOR CONTROL
(110 VAC, 1ø)

TYPICAL CONTROL SCHEMATIC



LOCAL OPERATOR ACTUATED
PUSH-BUTTON MOTOR CONTROL
(480 VAC, 3ø)

TYPICAL CONTROL SCHEMATIC

NOTES

1. POWER TO PROCESS EQUIPMENT WILL BE CONTROLLED BY THE EMERGENCY- STOP RELAY(S) M1, SEE DIAGRAM THIS SHEET.
2. POWER TO THE PLC AND INSTRUMENTATION WILL ALWAYS BE AVAILABLE ALLOWING FOR CONSTANT MONITORING AND DATA AQUISITION, EVEN IN A SHUTDOWN CONDITION.
3. ALL MOTORS WILL REQUIRE A LOCAL DISCONNECT SWITCH (WITHIN SIGHT OF MOTOR).

FOR DRAWING INDEX SEE DRAWING NO. T-1	SUBCONTRACT NO. N/A	INEEL
NO SCALE	REQUESTOR: G. McDANNEL DESIGN: SCOTT ALLEN DRAWN: F.A. HAYNER PROJECT NO. 22901 SPEC CODE	EX SITU CHEMICAL OXIDATION/REDUCTION/STABILIZATION OF THE V-TANKS AT TEST AREA NORTH OPERABLE UNIT 1-10 POWER 3 LINE AND CONTROL DIAGRAMS
DESIGN PHASE: CONCEPTUAL	FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.	SIZE D CAGE CODE 01MF3 INDEX CODE NUMBER AREA 034 TYPE 0400 CL 10 DWG 090 DWG- REV
SAFETY CATEGORY: CG	EFFECTIVE DATE:	SCALE: NONE SHEET E-1

REVISIONS		
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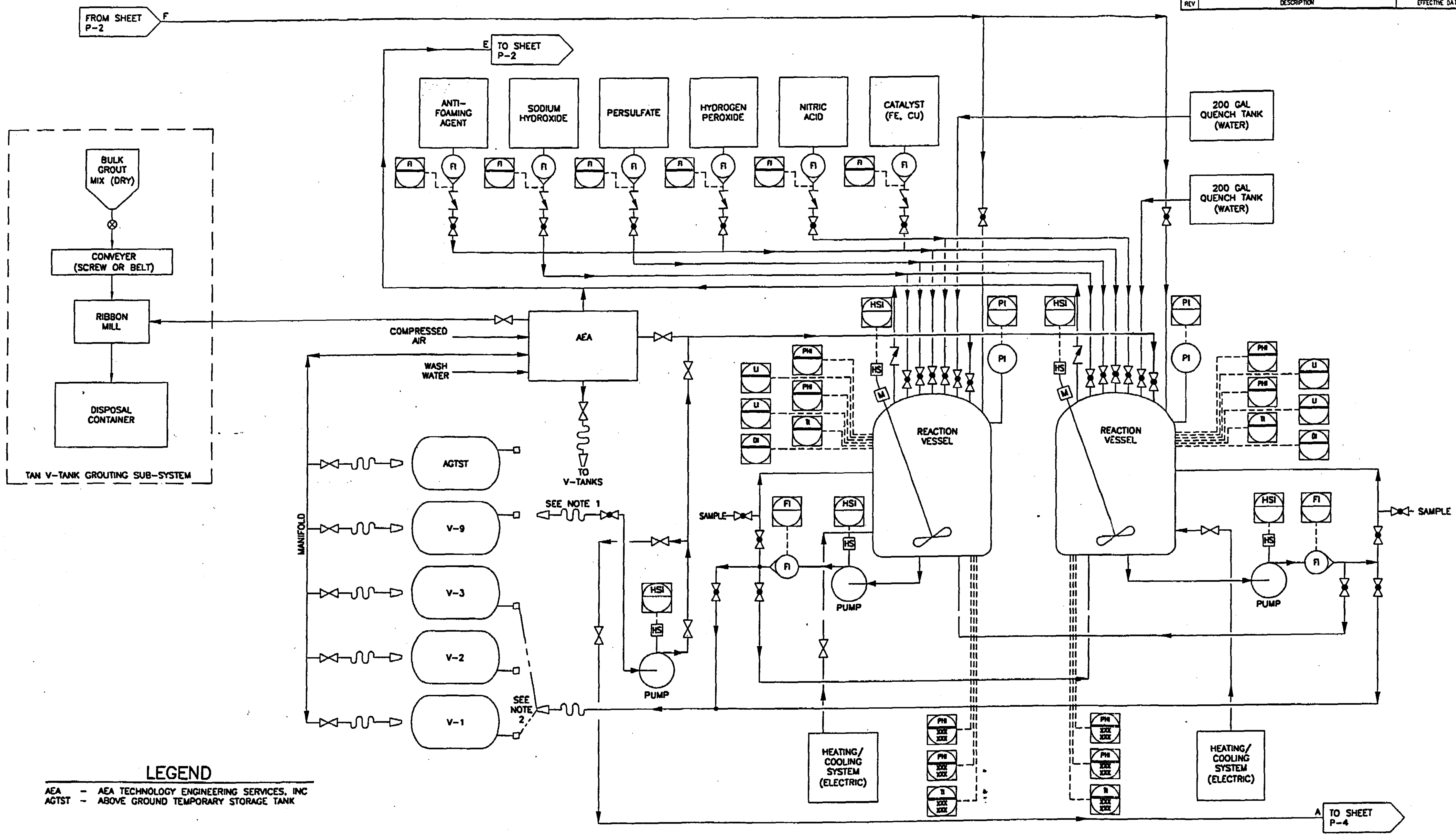

LEGEND

AEA – AEA TECHNOLOGY ENGINEERING SERVICES, INC
AGTST – ABOVE GROUND TEMPORARY STORAGE TANK

NOTES

1. FLEX LINE TO BE OF SUFFICIENT LENGTH TO CONNECT TO V-TANKS AND AGTST AS REQUIRED BY PROCESS NEEDS.
2. MOVE LINE BETWEEN TANKS V-1 AND V-3 AS REQUIRED BY PROCESS.

REVISIONS		
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SUBCONTRACT NO. N/A
REQUESTER: G. McDANNEL
DESIGN: KERRY WARD
DRAWN: F.A. HAYNER
PROJECT NO. 22901
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
EFFECTIVE DATE:
NO SCALE
DESIGN PHASE: CONCEPTUAL
SAFETY CATEGORY: CG

INEEL

EX SITU CHEMICAL OXIDATION/REDUCTION/STABILIZATION OF THE V-TANKS AT TEST AREA NORTH OPERABLE UNIT 1-10
PIPING AND INSTRUMENTATION DIAGRAM

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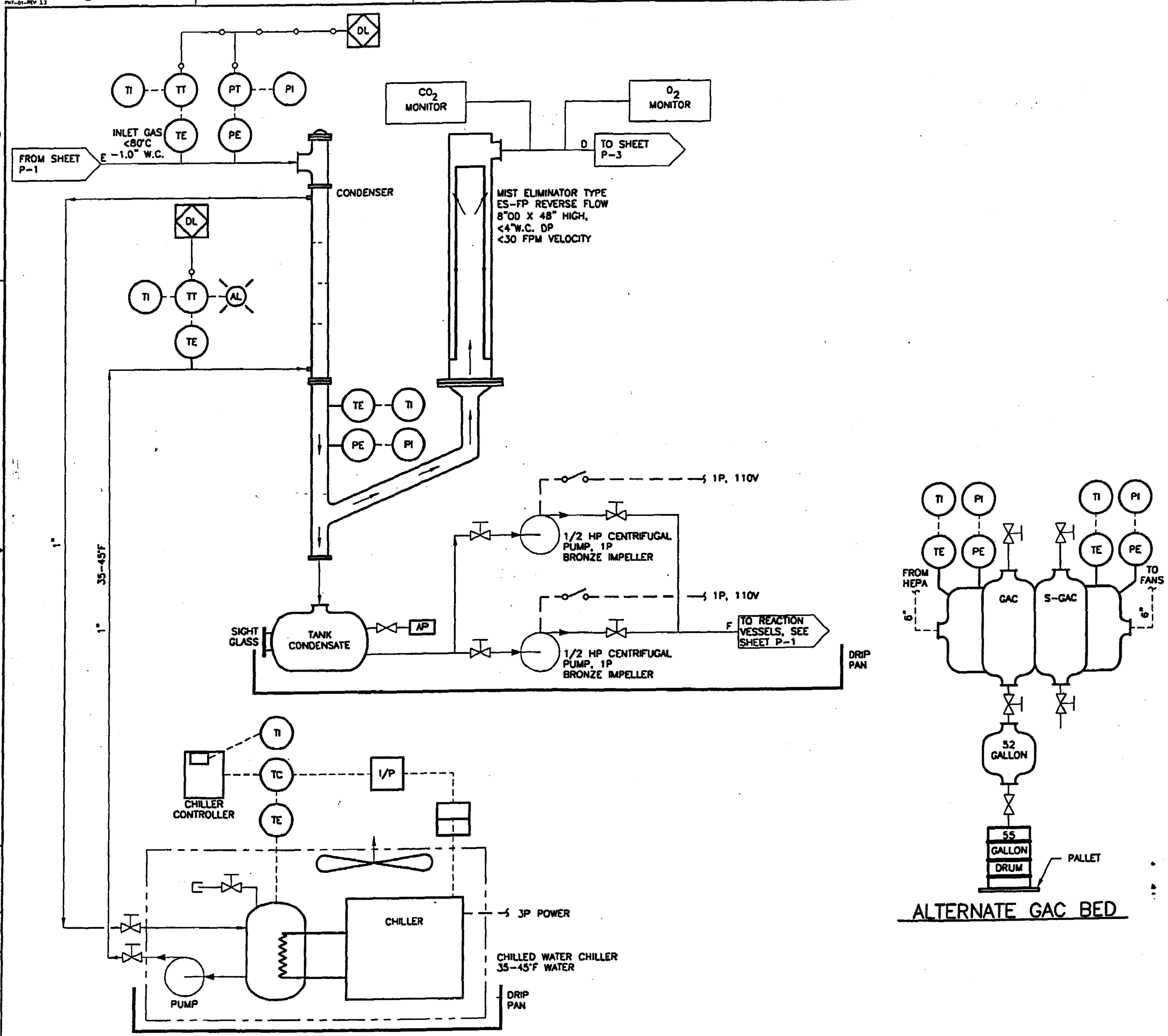

ALTERNATE GAC BED

LEGEND

- VENTURI
- ALARM
- DATA LOGGER
- HAND SWITCH
- HAND DAMPER
- ELECTRICAL SIGNAL
- PIPING LINE
- SOFTWARE OR DATA LINK
- POWER
- PNEUMATIC

LEGEND

AP	ANALYSIS PORT
FPM	FEET PER MINUTE
GAC	GRANULATED ACTIVATED CARBON
PI	PRESSURE INDICATOR
PE	PRESSURE ELEMENT
PT	PRESSURE TRANSMITTER
S-GAC	SULFUR IMPREGNATED GRANULATED ACTIVATED CARBON
TC	TEMPERATURE CONTROL
TE	TEMPERATURE ELEMENT
TI	TEMPERATURE INDICATOR
TT	TEMPERATURE TRANSMITTER
WC	WATER COLUMN

NOTES

1. SIZE TO MAINTAIN CONSTANT TEMPERATURE IN HEPA & GAC BEDS.
2. HEAT TRACE AND INSULATE OR PLACE IN HEATED TRAILER.
3. FOR POWER 3 LINE AND CONTROL DIAGRAMS SEE SHEET E-1.
4. FOR TYPICAL INSTRUMENTATION LOOP DIAGRAMS SEE SHEET IN-1.

REVISIONS

REV	DESCRIPTION	EFFECTIVE DATE:

FOR DRAWING INDEX SEE DRAWING NO. T-1	SUBCONTRACT NO. N/A
NO SCALE	REQUESTER: G. McDANNEL
	DESIGN: B. RAVO
	DRAWN: F.A. HAYNER
	PROJECT NO. 22901
	SPEC CODE
DESIGN PHASE: CONCEPTUAL	FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
SAFETY CATEGORY: CG	EFFECTIVE DATE:

INEEL

EX SITU CHEMICAL
OXIDATION/REDUCTION/STABILIZATION
OF THE V-TANKS AT TEST AREA NORTH
OPERABLE UNIT 1-10
CONDENSATE PROCESS P&ID

SIZE	CAGE CODE	AREA	TYPE	CL	ORG	DWG-	REV
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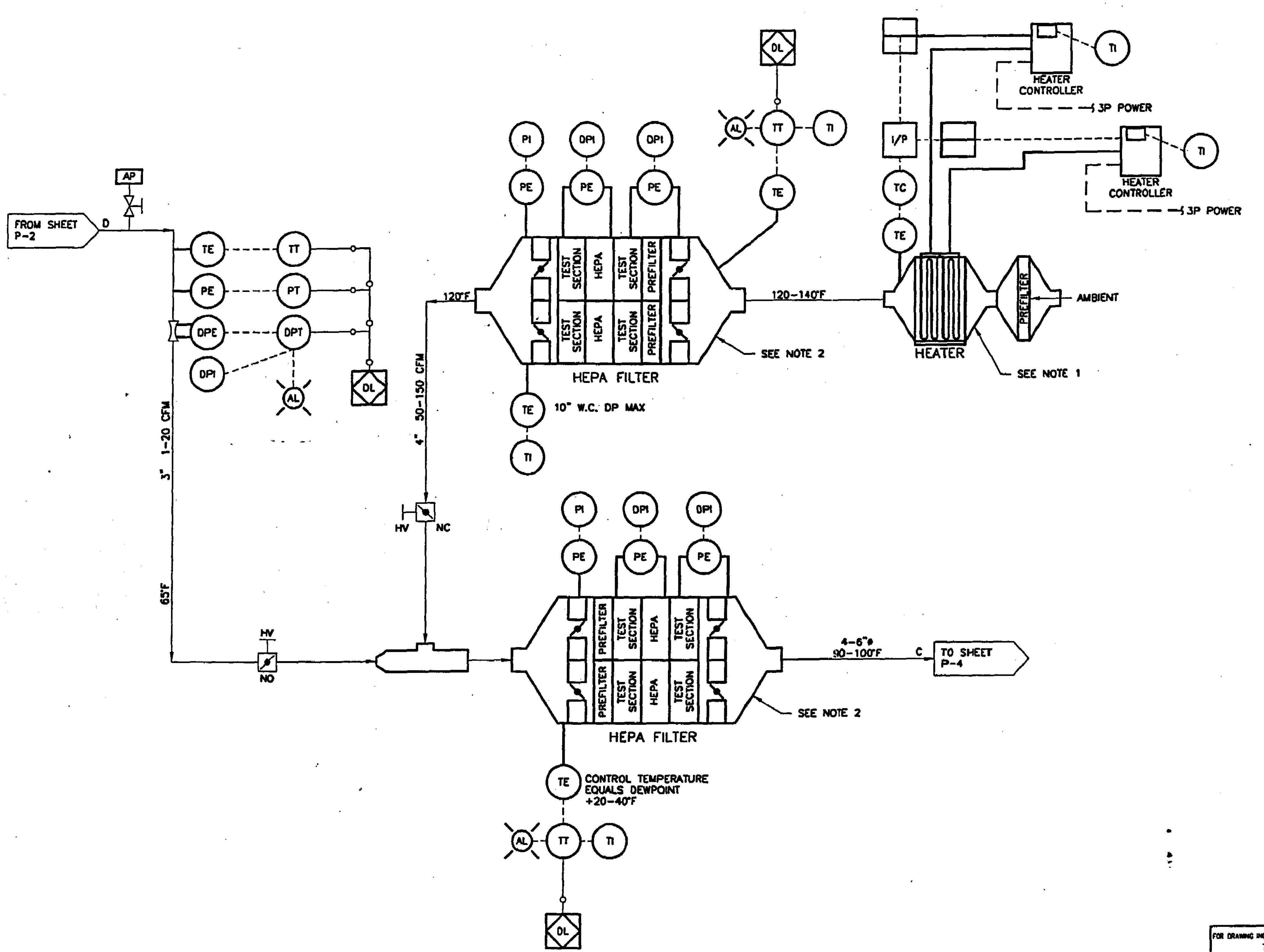

LEGEND

(venturi symbol)	VENTURI
AL	ALARM
DL	DATA LOGGER
(hand switch symbol)	HAND SWITCH
(hand damper symbol)	HAND DAMPER
- - - - -	ELECTRICAL SIGNAL
———	PIPING LINE
—o—	SOFTWARE OR DATA LINK
— — —	POWER
—//—	PNEUMATIC

LEGEND

AP ANALYSIS PORT
ACFM ACTUAL CUBIC FEET PER MINUTE
DPE DIFFERENTIAL PRESSURE ELEMENT
DPI DIFFERENTIAL PRESSURE INDICATOR
DPT DIFFERENTIAL PRESSURE TRANSMITTER
GAC GRANULATED ACTIVATED CARBON
HS HAND SWITCH
I/P PROCESS CONTROL INPUT
NC NORMALLY CLOSED
NO NORMALLY OPEN
PI PRESSURE INDICATOR
PE PRESSURE ELEMENT
PT PRESSURE TRANSMITTER
SCFM STANDARD CUBIC FEET PER MINUTE
S-GAC SULFUR IMPREGNATED GRANULATED ACTIVATED CARBON
TC TEMPERATURE CONTROL
TE TEMPERATURE ELEMENT
TI TEMPERATURE INDICATOR
TT TEMPERATURE TRANSMITTER
VOC VOLATILE ORGANIC COMPOUND
WC WATER COLUMN

NOTES

1. SIZE TO MAINTAIN CONSTANT TEMPERATURE IN HEPA & GAC BEDS.
2. HEAT TRACE AND INSULATE OR PLACE IN HEATED TRAILER.
3. FOR POWER 3 LINE AND CONTROL DIAGRAMS SEE SHEET E-1.
4. FOR TYPICAL INSTRUMENTATION LOOP DIAGRAMS SEE SHEET IN-1.

REVISIONS

REV	DESCRIPTION	EFFECTIVE DATE:

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DESIGN PHASE: CONCEPTUAL
SAFETY CATEGORY: CG
SUBCONTRACT NO. N/A
REQUESTER: G. McDANNEL
DESIGN: B. RAND
DRAWN: F.A. HAYNER
PROJECT NO. 22901
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
EFFECTIVE DATE:

INEEL

EX SITU CHEMICAL OXIDATION/REDUCTION/STABILIZATION OF THE V-TANKS AT TEST AREA NORTH OPERABLE UNIT 1-10
OFFGAS SYSTEM P&ID – SHEET 1

SIZE D | CAGE CODE 01MF3 | INDEX CODE NUMBER: AREA 034, TYPE 0300, CL 52, ORG 090 | DWG- | REV
SCALE: NONE | SHEET P-3

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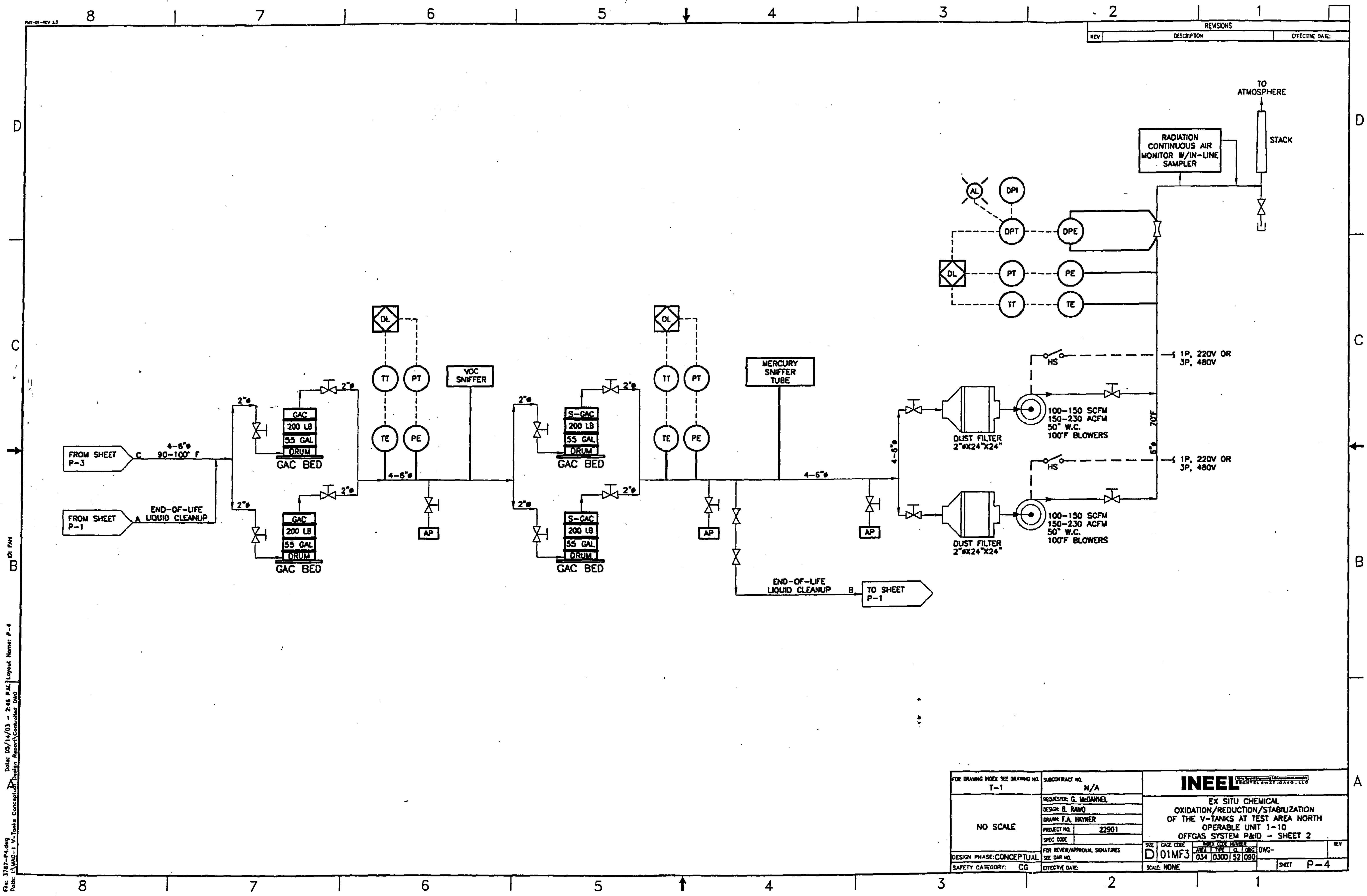

REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE:
TO ATMOSPHERE
STACK
RADIATION CONTINUOUS AIR MONITOR W/IN-LINE SAMPLER
AL
DPI
DPT
DPE
DL
PT
PE
TT
TE
HS
1P, 220V OR 3P, 480V
100-150 SCFM
150-230 ACFM
50" W.C.
100°F BLOWERS
70°F
6"ø
DUST FILTER 2"øX24"X24"
4-6"ø
MERCURY SNIFFER TUBE
VOC SNIFFER
AP
END-OF-LIFE LIQUID CLEANUP
TO SHEET P-1
FROM SHEET P-3
FROM SHEET P-1
90-100° F
2"ø
GAC
S-GAC
200 LB
55 GAL
DRUM
GAC BED
FOR DRAWING INDEX SEE DRAWING NO. T-1
NO SCALE
DESIGN PHASE: CONCEPTUAL
SAFETY CATEGORY: CG
SUBCONTRACT NO. N/A
REQUESTER: G. McDANNEL
DESIGN: B. RAWO
DRAWN: F.A. HAYNER
PROJECT NO. 22901
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES
SEE DAR NO.
EFFECTIVE DATE:
INEEL
EX SITU CHEMICAL
OXIDATION/REDUCTION/STABILIZATION
OF THE V-TANKS AT TEST AREA NORTH
OPERABLE UNIT 1-10
OFFGAS SYSTEM P&ID - SHEET 2
SIZE D
CAGE CODE 01MF3
INDEX CODE NUMBER 034 0300 52 090
DWG-
REV
SCALE: NONE
SHEET P-4
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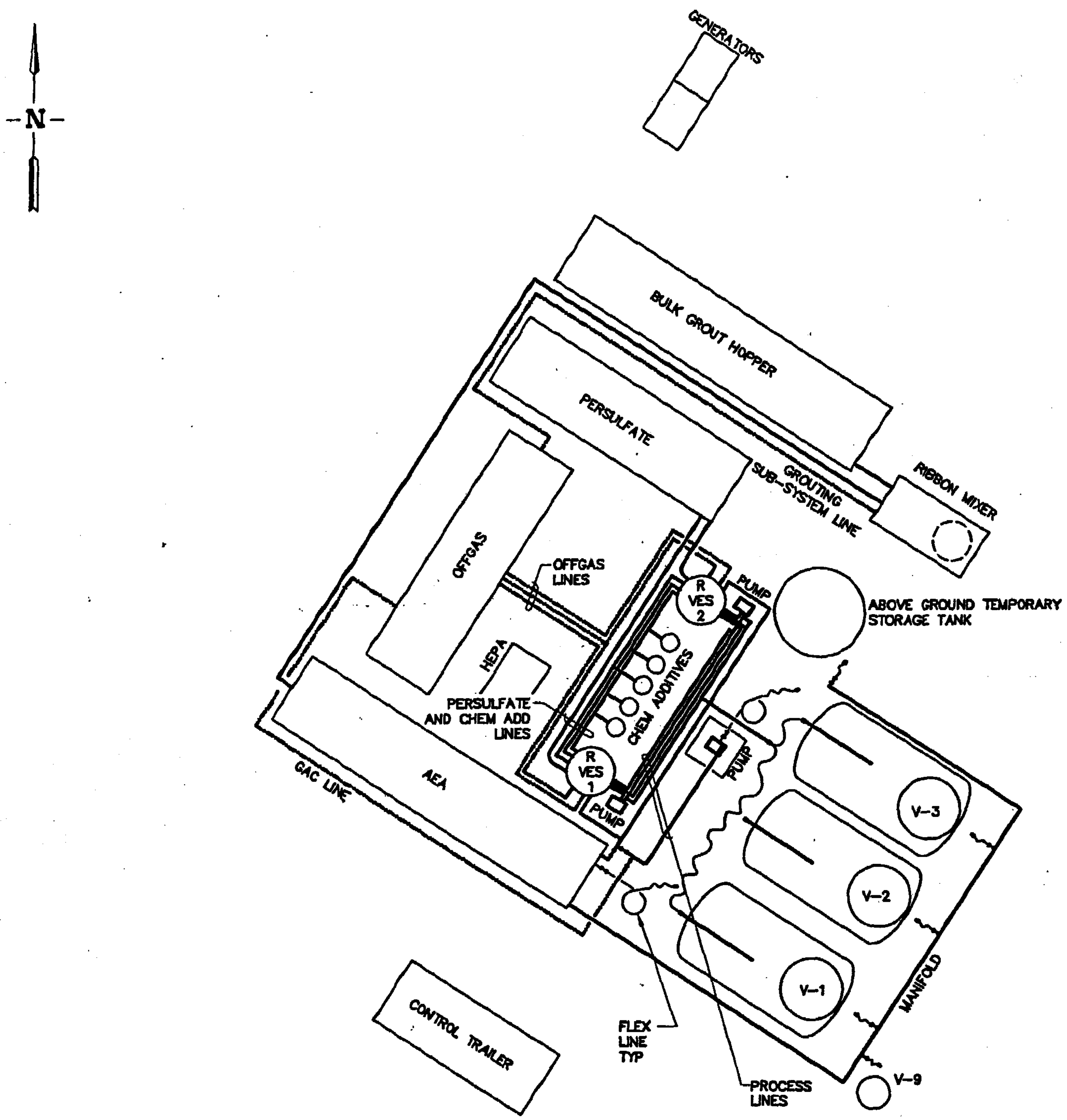

PIPING PLAN

REV	DESCRIPTION	EFFECTIVE DATE
	REVISIONS	

FOR DRAWING INDEX SEE DRAWING NO. T-1

SCALE: 1/8" = 1'-0"

DESIGN PHASE: CONCEPTUAL

SAFETY CATEGORY: CG

SUBCONTRACT NO. N/A

REQUESTER: N.K. Rogers

DESIGN: K. Ward

DRAWN: K. Bronson

PROJECT NO. 22901

SPCL CODE

FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.

EFFECTIVE DATE:

INEEL

EX SITU CHEMICAL OXIDATION/REDUCTION/STABILIZATION OF THE V-TANKS AT TEST AREA NORTH OPERABLE UNIT 1-10

PIPING PLAN

SIZE	CAGE CODE	AREA	TYPE	CL	ORG	DWG-	REV
D	01MF3	034	0200	51	090		

SCALE: 1/8"=1'-0" SHEET P-5

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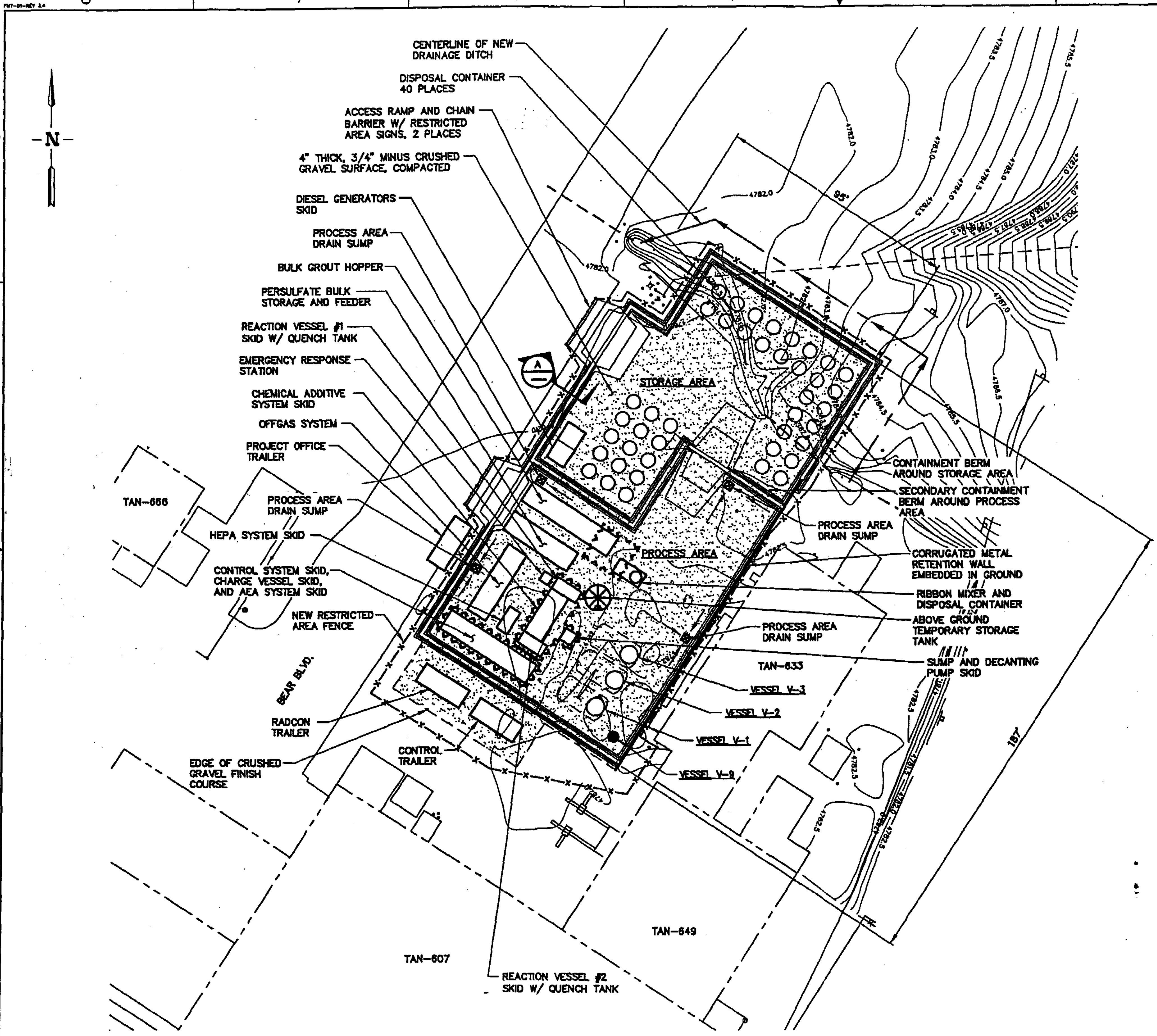
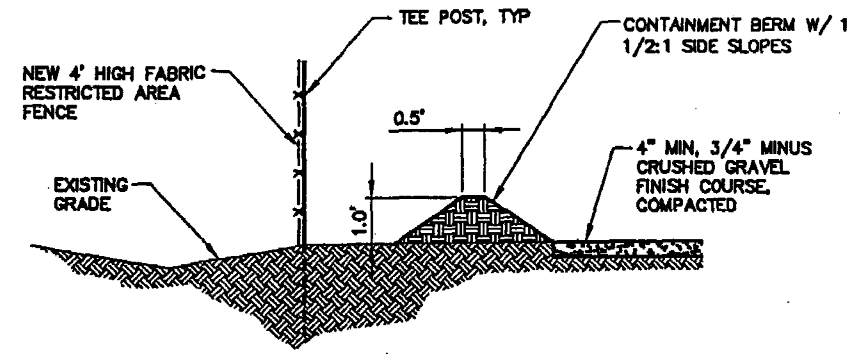
ID: MXJ



AREA PLAN
SCALE: 1"=20.0'



SECTION (A)
SCALE: 1"=2.0'

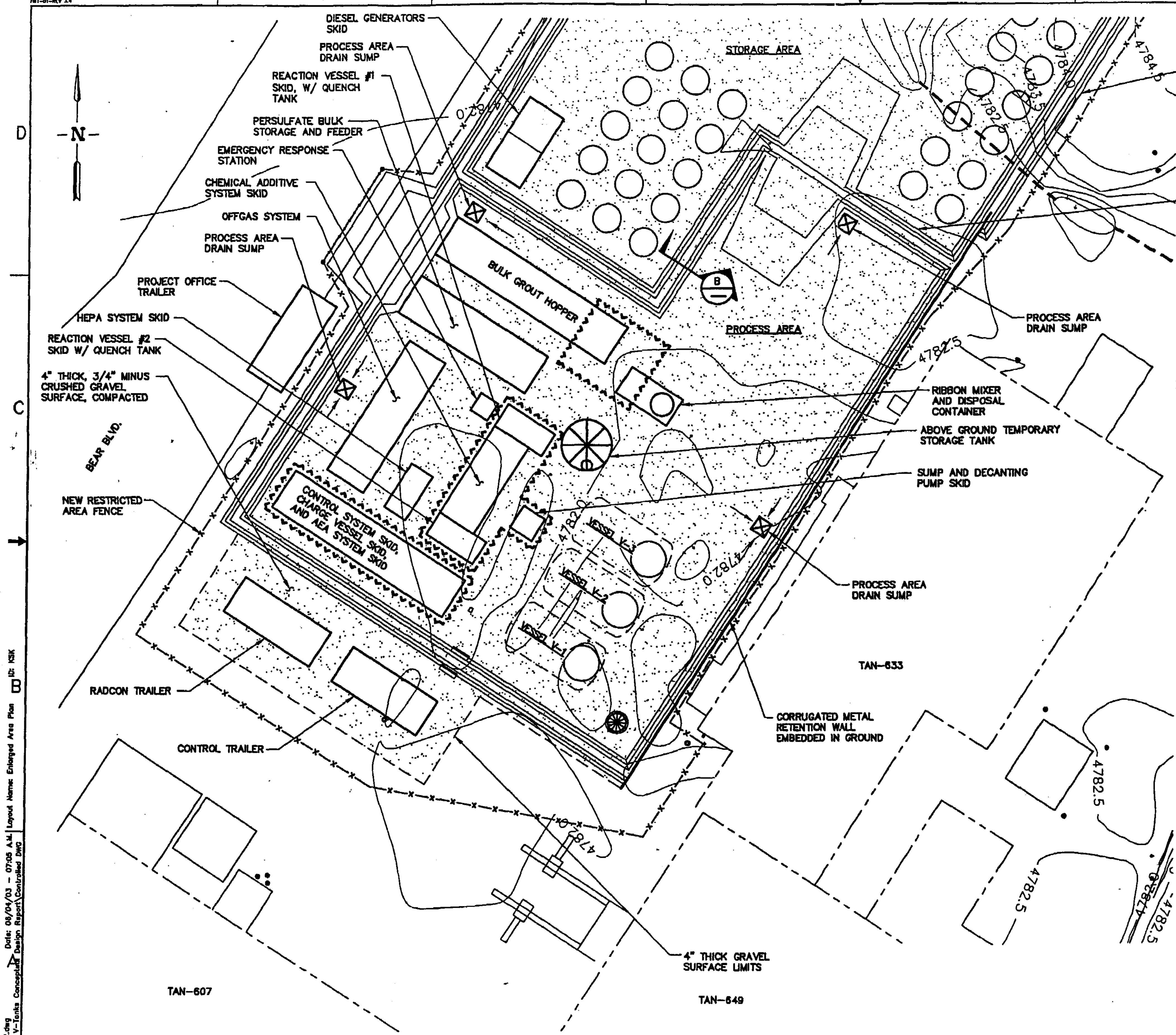
LEGEND

INDICATES TENT ENCLOSURE AROUND PROCESS EQUIPMENT

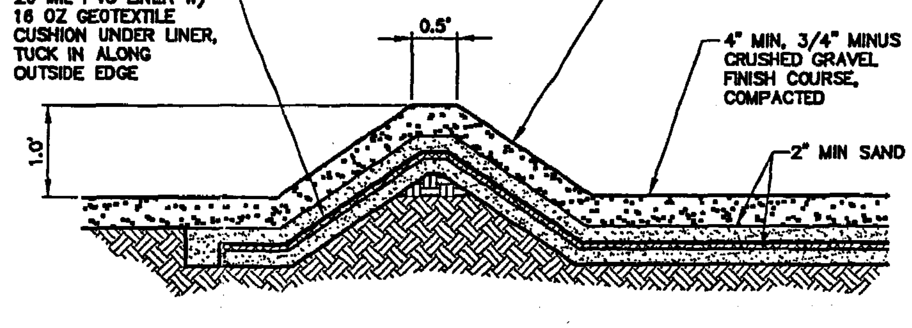
REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE

FOR DRAWING INDEX SEE DRAWING NO. T-1	SUBCONTRACT NO. N/A	INEEL
SCALE: 1" = 20.0'	REQUESTER: N.K. Rogers	EX SITU CHEMICAL OXIDATION/REDUCTION/STABILIZATION OF THE V-TANKS AT TEST AREA NORTH OPERABLE UNIT 1-10 AREA PLAN AND SECTION
SCALE: 1" = 2.0'	DESIGN: P.W. Bregoss	
	DRAWN: S.K. Kutterer	
	PROJECT NO. 22901	
	SPCL CODE	SIZE D; CAGE CODE 01MF3; INDEX CODE NUMBER: AREA 034, TYPE 0100, CL 02, OBJ 090; DWG- ; REV
DESIGN PHASE: CONCEPTUAL	FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.	
SAFETY CATEGORY: CG	EFFECTIVE DATE:	SCALE NOTED; SHEET C-1

File: 3787-C1_2.dwg Date: 08/04/03 - 07:04 A.M. Layout Name: Plan ID: KSK
Path: J:\WAG-1 V-Tanks Conceptual Design Report\Controlled DWG



ENLARGED AREA PLAN
SCALE: 1"=10.0'



SECTION B/–
SCALE: 1"=1.0'

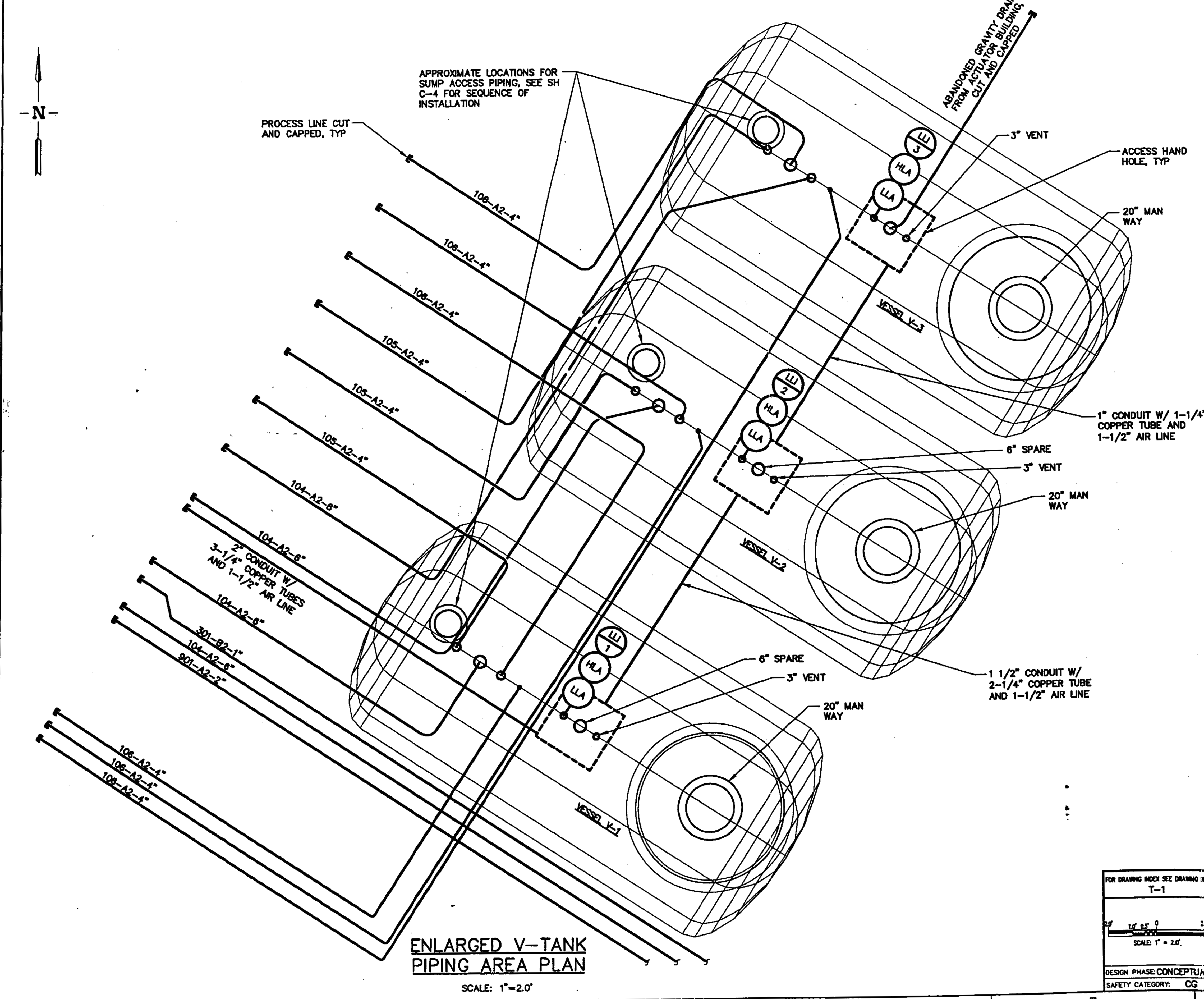
LEGEND

INDICATES TENT ENCLOSURE AROUND PROCESS EQUIPMENT

FOR DRAWING INDEX SEE DRAWING NO. T-1	SUBCONTRACT NO. N/A	INEEL
SCALE: 1" = 10.0'	REQUESTER: N.K. Rogers	EX SITU CHEMICAL OXIDATION/REDUCTION/STABILIZATION OF THE V-TANKS AT TEST AREA NORTH OPERABLE UNIT 1-10 ENLARGED AREA PLAN AND SECTION
SCALE: 1" = 1.0'	DESIGN: P.W. Bragassa	
	DRAWN: S.K. Kutterer	
	PROJECT NO. 22901	SIZE D; CAGE CODE 01MF3; INDEX CODE NUMBER: AREA 034, TYPE 0100, CL 02, DISC 090; DWG- ; REV
	SPC. CODE	
DESIGN PHASE: CONCEPTUAL	FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.	SCALE: NOTED
SAFETY CATEGORY: CG	EFFECTIVE DATE:	SHEET C-2

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:

File: 3787-C1_2.dwg Date: 08/04/03 - 07:05 A.M. Layout Name: Enlarged Area Plan ID: KSK
Path: J:\WAG-1 V-Tanks Conceptual Design Report\Controlled DWG



LEGEND

LLI X	LOW LEVEL INDICATOR
HLA	HIGH LEVEL ALARM
LLA	LOW LEVEL ALARM

ENLARGED V-TANK
PIPING AREA PLAN

SCALE: 1"=2.0'

REV	DESCRIPTION	EFFECTIVE DATE:
	REVISIONS	

FOR DRAWING INDEX SEE DRAWING NO. T-1

2.0' 1.0' 0.5' 0 2.0'
SCALE: 1" = 2.0'

DESIGN PHASE: CONCEPTUAL
SAFETY CATEGORY: CG

SUBCONTRACT NO. N/A
REQUESTER: N.K. Rogers
DESIGN: P.W. Brogasse
DRAWN: S.K. Kutterer
PROJECT NO. 22901
SPCL CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
EFFECTIVE DATE:

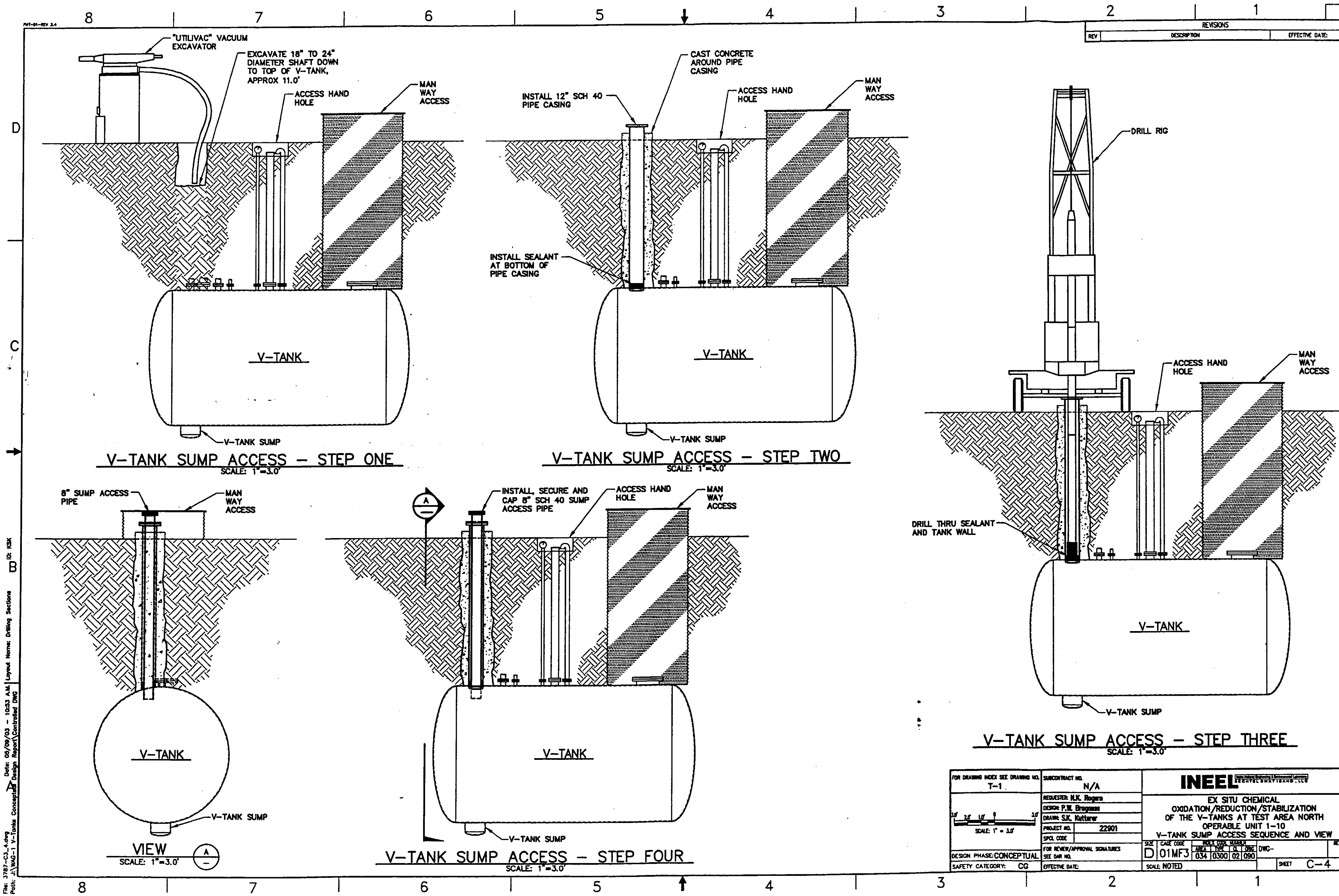
INEEL BECHTEL BWXT IDAHO, LLC

EX SITU CHEMICAL
OXIDATION/REDUCTION/STABILIZATION
OF THE V-TANKS AT TEST AREA NORTH
EXISTING V-TANK PIPING
ENLARGED V-TANK PIPING AREA PLAN

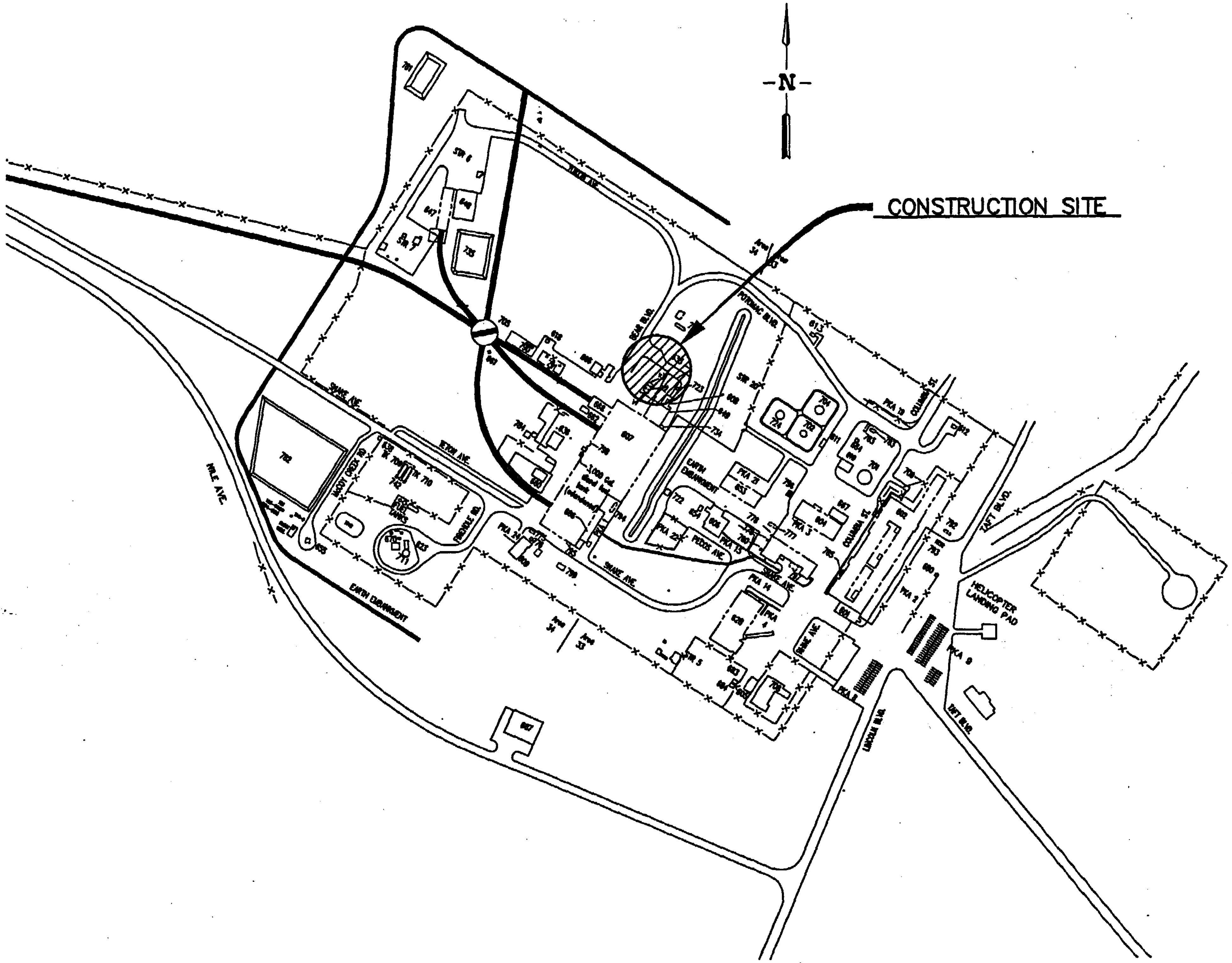
SIZE D | CAGE CODE 01MF3 | INDEX CODE NUMBER: AREA 034 TYPE 0300 CL 02 ORIG 090 | DWG- | REV
SCALE: NOTED | SHEET C-3

FMT-01-REV 3.4

File: 3787-C3_4.dwg Date: 05/09/03 - 10:35 A.M. Layout Name: Enlarged Area Plan ID: KSK
Path: J:\WAG-1 V-Tanks Conceptual Design Report\Controlled DWG



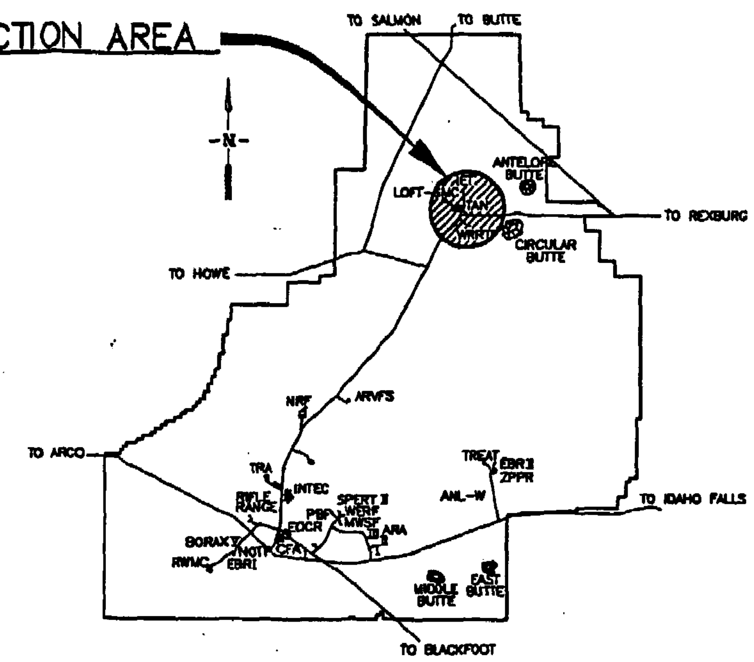
"UTILIVAC" VACUUM EXCAVATOR
EXCAVATE 18" TO 24" DIAMETER SHAFT DOWN TO TOP OF V-TANK, APPROX 11.0'
ACCESS HAND HOLE
MAN WAY ACCESS
V-TANK
V-TANK SUMP
V-TANK SUMP ACCESS - STEP ONE
SCALE: 1"=3.0'
INSTALL 12" SCH 40 PIPE CASING
CAST CONCRETE AROUND PIPE CASING
INSTALL SEALANT AT BOTTOM OF PIPE CASING
V-TANK SUMP ACCESS - STEP TWO
DRILL RIG
DRILL THRU SEALANT AND TANK WALL
V-TANK SUMP ACCESS - STEP THREE
8" SUMP ACCESS PIPE
VIEW
INSTALL, SECURE AND CAP 8" SCH 40 SUMP ACCESS PIPE
V-TANK SUMP ACCESS - STEP FOUR
REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE:
FOR DRAWING INDEX SEE DRAWING NO. T-1
SCALE: 1" = 3.0'
DESIGN PHASE: CONCEPTUAL
SAFETY CATEGORY: CG
SUBCONTRACT NO. N/A
REQUESTER: N.K. Rogers
DESIGN: P.W. Bragassa
DRAWN: S.K. Kutterer
PROJECT NO. 22901
SPCL CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
EFFECTIVE DATE:
INEEL
EX SITU CHEMICAL OXIDATION/REDUCTION/STABILIZATION OF THE V-TANKS AT TEST AREA NORTH OPERABLE UNIT 1-10
V-TANK SUMP ACCESS SEQUENCE AND VIEW
SIZE D
CAGE CODE 01MF3
INDEX CODE NUMBER AREA 034 TYPE 0300 Q 02 DWG 090
DWG-
REV
SCALE: NOTED
SHEET C-4
File: 3787-C3_4.dwg
Path: J:\WAG-1 V-Tanks Conceptual Design Report\Controlled DWG
Date: 05/09/03 - 10:53 A.M.
Layout Name: Drilling Sections
ID: KSK



TAN AREA MAP

SCALE: 1"=200.0'

HORIZONTAL DATUM BASED ON SITE SPECIFIC COORDINATES



INEEL SITE MAP

SCALE: NONE

REV	DESCRIPTION	EFFECTIVE DATE

REVISIONS

DRAWING INDEX

PAGE NO.	DWG NO.	A–E SH NO.	REV	DRAWING TITLE
1		T–1		SITE MAP, AREA MAP AND DRAWING INDEX
2		C–1		AREA PLAN AND SECTION
3		C–2		ENLARGED AREA PLAN AND SECTION
4		C–3		ENLARGED V–TANK PIPING AREA PLAN
5		C–4		V–TANK SUMP ACCESS SEQUENCE AND VIEW
6		P–1		PIPING AND INSTRUMENTATION DIAGRAM
7		P–2		CONDENSATE PROCESS P & ID
8		P–3		OFFGAS SYSTEM P & ID – SHEET 1
9		P–4		OFFGAS P & ID – SHEET 2
10		P–5		PIPING PLAN
11		E–1		POWER 3 LINE AND CONTROL DIAGRAMS
12		IN–1		TYPICAL LOOP DIAGRAMS

FOR DRAWING INDEX SEE DRAWING NO. T–1	SUBCONTRACT NO. N/A	**INEEL**
SCALE: 1" = 200.0'	REQUESTER: N.K. Rogers	EX SITU CHEMICAL OXIDATION/REDUCTION/STABILIZATION OF THE V–TANKS AT TEST AREA NORTH OPERABLE UNIT 1–10
	DESIGN: P.W. Bragassa	SITE MAP, AREA MAP AND DRAWING INDEX
	DRAWN: S.K. Kulbarer	SIZE D; CAGE CODE 01MF3; INDEX CODE NUMBER 034 0100 01 090; DWG–
	PROJECT NO. 22901	
	SPEC CODE	
DESIGN PHASE: CONCEPTUAL	FOR REVIEW/APPROVAL SIGNATURES	SCALE: NOTED
SAFETY CATEGORY: CG	EFFECTIVE DATE	SHEET T–1

File: 3787-T1.dwg
Path: J:\WAG-1 V-Tanks Conceptual Design 65/60%\EnviroBRT.BWGAL
Layout Name: Layout1
ID: KSK